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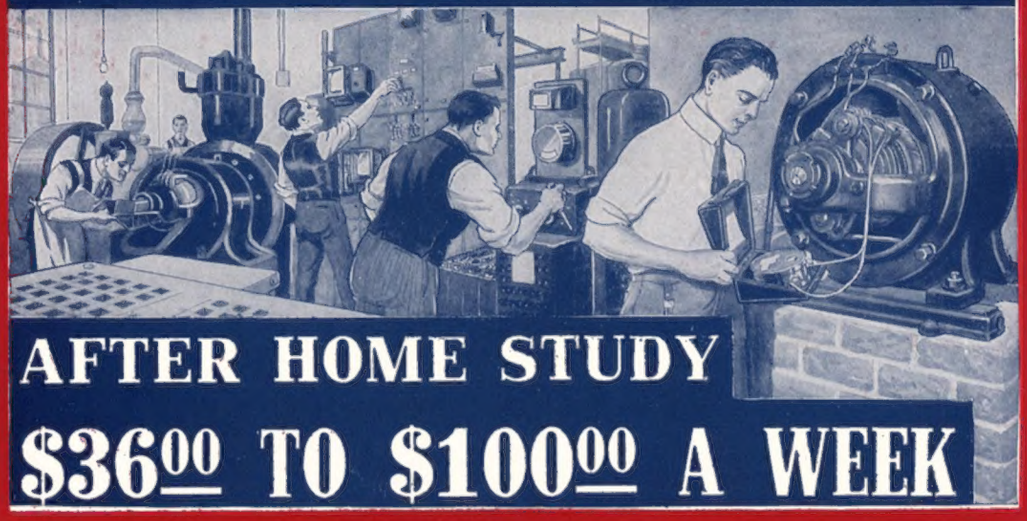

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Silencing America's Wireless

AS all our readers are aware the United States Government, thru the Navy Department, has issued orders thruout the land to cause the immediate dismantling of all radio stations, whether large or small, commercial or amateur, sending or receiving. All aerials have been ordered dismantled and apparatus packed away.

This action came as a great surprise to all patriotic amateurs, who for years past had been encouraged by the Government and who were certain that in time of war they would be allowed to "do their bit" with their outfits for the country.

That the Government should silence all *sending* outfits was eminently proper, and we have as yet to hear the first complaint on that score. But why the *receiving* outfits should be dismantled by the Navy Department is very puzzling indeed.

EXECUTIVE ORDER

WHEREAS the Senate and House of Representatives of the United States of America, in Congress assembled, have declared that a state of war exists between the United States and the Imperial German Government; and

Whereas it is necessary to operate certain radio stations for radio communication by the Government and to close other radio stations not so operated, to insure the proper conduct of the war against the Imperial German Government and the successful termination thereof

Now, therefore, it is ordered by virtue of authority vested in me by the Act to Regulate Radio Communication, approved August 13, 1912, that such radio stations within the jurisdiction of the United States as are required for Naval Communications shall be taken over by the Government of the United States and used and controlled by it, to the exclusion of any other control or use; and, furthermore, that all radio stations not necessary to the Government of the United States for Naval Communications may be closed for radio communication.

The enforcement of this order is hereby delegated to the Secretary of the Navy, who is authorized and directed to take such action in the premises as to him may appear necessary.

This order shall take effect from and after this date.

The White House,
6 April, 1917. (Signed) WOODROW WILSON.

President Wilson's Executive Order is based upon the Radio Act of 1912, which act however, mentions nothing about closing receiving stations during the time of war. That purely receiving stations were considered harmless by the framers of the law, is best proved by the fact that such stations do not require to be licensed as do all sending stations. Moreover, in President Wilsons's Executive Order of April 6, no mention is made of receiving stations. Indeed, the following passage strikes us as very significant:

"————and furthermore that all Radio Stations not necessary to the Government of the United States for *Naval Communications may* be closed for radio communication."

The italics are ours. Particularly the one word MAY. In the same paragraph the President uses the command SHALL, while the word *may* does not imply that every radio station should be taken over by the Navy Department. Indeed, the longer we study the third paragraph of the President's Executive order, the more we become convinced that the closing of every amateur station, or even commercial stations, was remote from President Wilson's mind when he issued his order.

In conformity to the Radio Act of 1912, the President in time of war, may authorize any department of the Government to close all radio stations. But the President's order of April 6, was not to the Department of Commerce, which in the past controlled the nation's radio affairs, *but to the Navy Department*. Why? Because the President, it seems to us, had only the radio communications of the Navy in mind. If, therefore, the Navy Department had caused the closing of all radio stations, particularly sending stations along our sea borders, such action would have seemed perfectly logical. But why the Navy Department should wish to close stations a thousand miles removed from the sea borders, seems to us very puzzling. Furthermore, why all college radio stations, and those belonging to radio apparatus manufacturers as well, should be dismantled seems far fetched. Then there are cases like the one of the Lackawanna Railroad, which is one of the pioneer railroads in the United States to use wireless for train dispatching. Is it wise to dismantle such stations on which the safety of passengers depends?

We certainly have no quarrel with the Navy Department; quite the contrary. We wish to help, but we sincerely do hope that its officials will soon find a way to modify its recent sweeping order.

There are, indeed, encouraging signs already. Certain commercial stations on the Pacific Coast have recently resumed operation, and it is to be hoped that amateurs will be allowed to operate their receiving stations, at a not too distant future. H. GERNSBACK.

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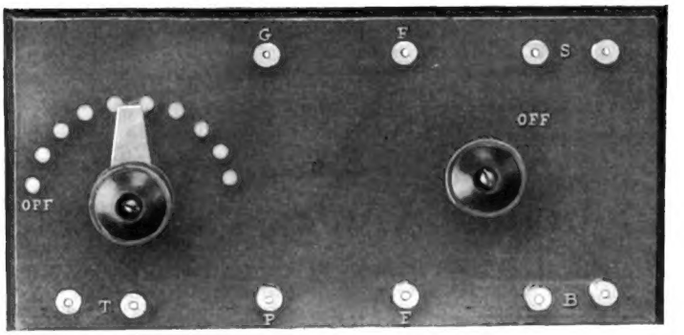

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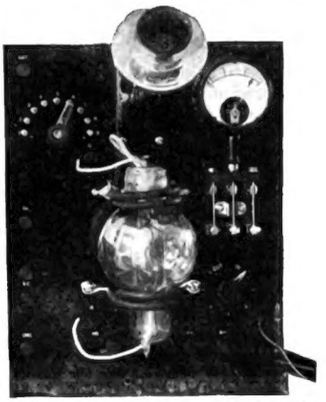

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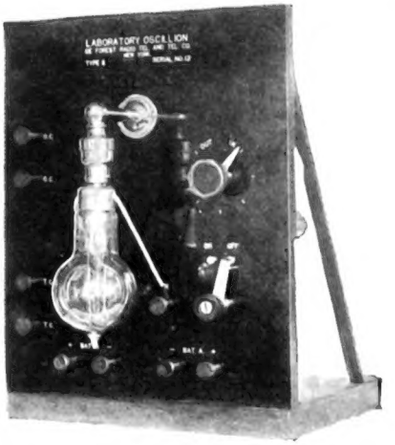

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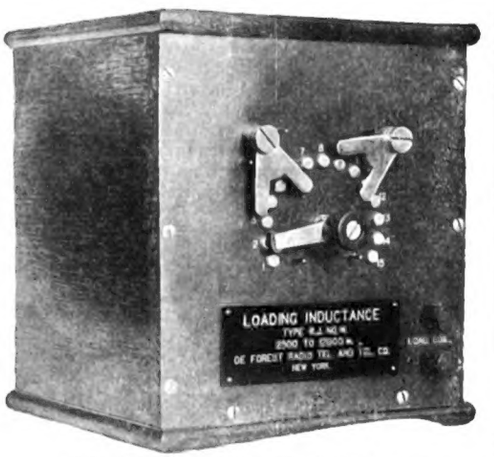

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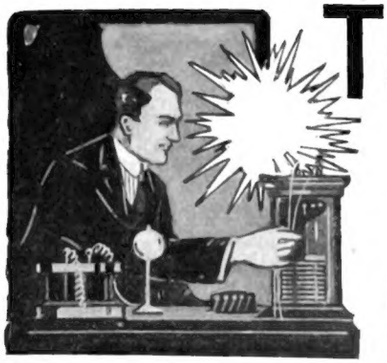


THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

Vol. V. Whole No. 50 | June, 1917 | Number 2

Electric Crossing Signal Operated by Train's Whistle

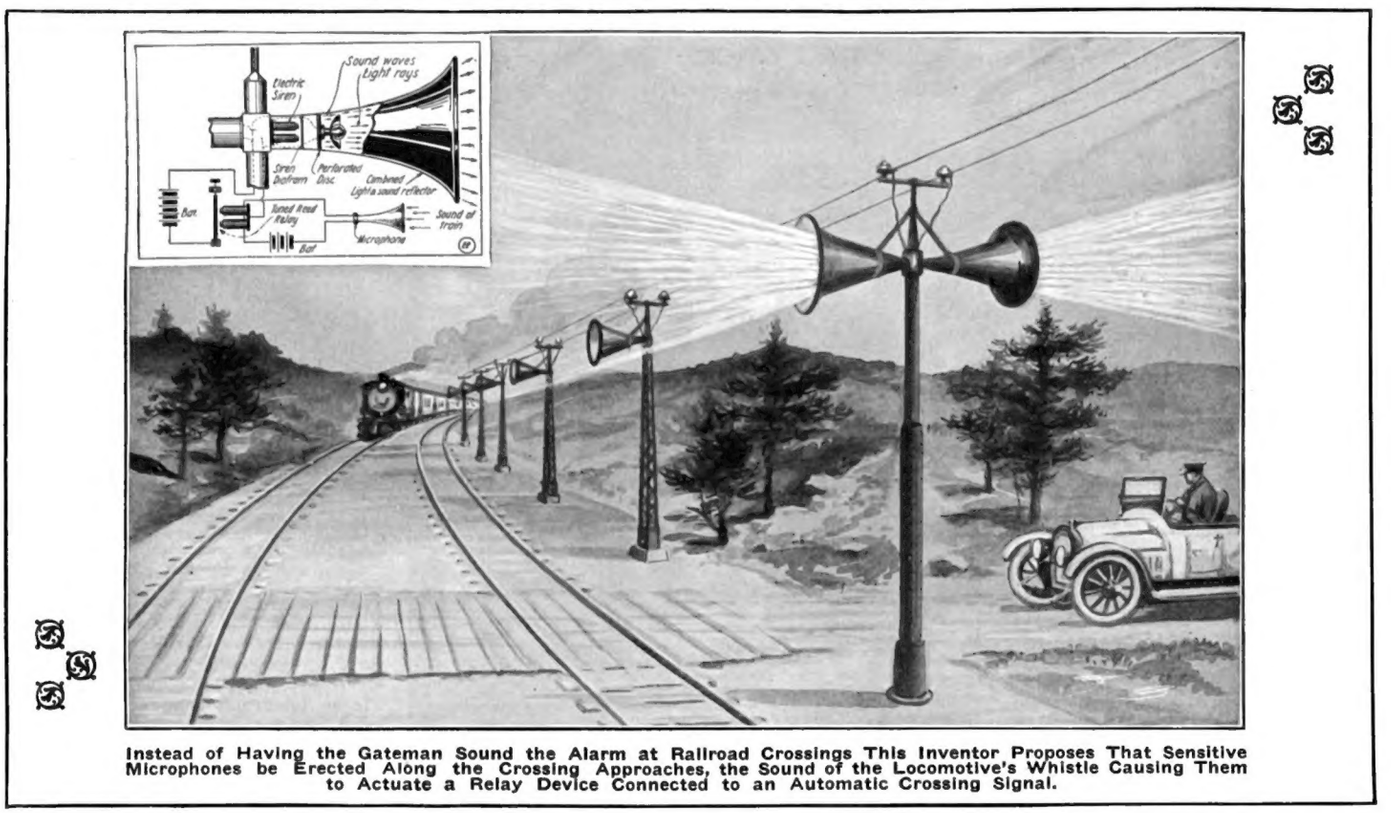
By GEORGE WALL

A NEW YORK genius has developed a clever idea for automatically sounding the alarm at railroad crossings, and whereby the alarm is controlled and actuated by the *whistle* of the approaching train itself. The accompanying illustration shows how the inventor proposes to mount a number of large size horns along the crossing-approaches, each horn being fitted with a super-sensitive electrical microphone, such as used in the well-known *Dictagraph*. When the train whistle sounds for the crossing these microphones, scattered along a distance of several hundred feet on either side of it, pick up the sounds and are caused to control a sensitive relay device operating on the tuned-reed principle. The relay will thus respond with maximum efficiency to a certain whistle tone, as the vibrating reed armature fitted to it is selected to vibrate sympathetically with the dominant note of the locomotive whistle.

When the approaching train's whistle has thus actuated the microphone and in turn the sensitive reed relay, the latter closes the proper circuits to a powerful electric siren installed at the top of the signal tower at the railroad crossing, as shown in the accompanying illustration and diagram of the elemental circuits. For night requirements, the alarm may consist of the electric siren and a powerful beam of light, both of which are projected out of the signal horn. The siren is enabled to project its sound out into the horn past the incandescent lamp, as the latter is mounted on a perforated disc, thus allowing the sound waves to pass by it. The alarm tower may carry two or more of these combined electric siren and lamp signals, and, as becomes evident, the operation of the device is extremely efficient; the alarm ceases as soon as the train has past the crossing.

There are, of course, several details which are not shown in the accompanying view, which would be necessary in carrying out and applying the plan here proposed. For one thing there would have to be some form of time-element device such as a slow-moving dash-pot attached to the sensitive relay, so that the relay could not open the siren and lamp circuits for a period of a minute or so; thus making certain that the signal will sound until the train has past the crossing. The idea is, all in all, quite novel and possesses many other possibilities.

The *microphone* has proven its worth in many difficult rôles in industrial as well as military and naval operations. The soldiers in Europe have found the sensitive microphone of extreme value in listening to enemy sappers as they picked and shoveled a mine below the listeners. Again the French have been enabled to accurately locate and "spot" an enemy submarine off shore by suitably disposing two or more specially tuned microphones along the coast at a known distance apart. Then by a simple triangulation computation on a clever slide rule, the distance at which the submarine happened to be, is readily found, and a fast patrol scout will be waiting for her when she arrives at the surface.



Instead of Having the Gateman Sound the Alarm at Railroad Crossings This Inventor Proposes That Sensitive Microphones be Erected Along the Crossing Approaches, the Sound of the Locomotive's Whistle Causing Them to Actuate a Relay Device Connected to an Automatic Crossing Signal.

Chances for Electricians in the Navy

The U. S. Navy now offers excellent chances to ambitious young men who have a desire to learn a trade and learn it right. The naval electrician has unequaled opportunities for attaining an exceedingly broad and substantial electrical knowledge, covering dynamos and motors, wiring of all kinds, special and standard signaling systems, telephone systems, radio apparatus, and a host of other things with which the average "land-lubber" may never become thoroly familiar. U. S. naval electricians never need to fear that they can not land a job after their service in the navy is finished.

Naval service offers many inducements to ambitious and spirited young men. Not only does it provide opportunities for free travel in many nearby and distant waters with changing scenes, but it furnishes excellent training of high value in civil pursuits at the conclusion of enlistment. It also furnishes steady, healthful work, free board of a wholesome nature, free lodging and clothing, and in addition provides pay, even during the period of training, that can be practically all set aside for saving. The United States Navy pays its enlisted men better than any other national navy and in most lines more than the men could save and in some cases even more than they would receive in similar pursuits in civil life. Above all this it enables the men to render the highest patriotic service open to the citizens of any nation, that of defending the security of their country in the first line of defense.

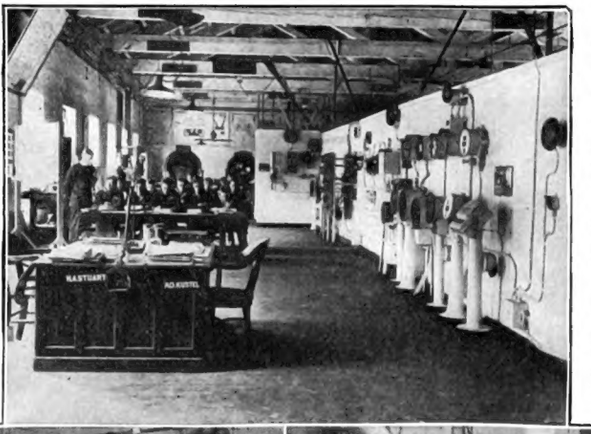
The many uses of electricity aboard ship and in the naval stations have been steadily increasing. It is used not only for lighting and power service, but also for communication and signaling, and even for cooking and baking. There are a multitude of electric motors in use for ventilating blowers, ammunition hoists and conveyors, gun-pointing equipments, turret-turning machinery, and various other purposes. These motors are supplied thru special control apparatus from turbogenerators, engine-driven dynamos, motor-generators, etc. The lighting equipment includes incandescent and arc lamps, searchlights of the highest powers, special signal lamps, etc. Communication apparatus consists chiefly of telephones and radiotelegraphic sets. Machinery and apparatus in use in the Navy are of the highest types, consequently the training and experience received in their operation and maintenance are of exceptional value to the electrician or radio operator in after life.

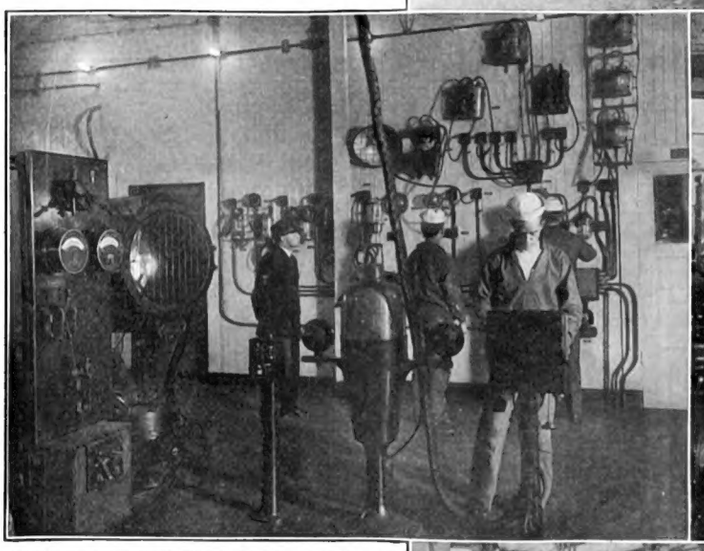
Since the proper operation and care of all the varied electrical apparatus is essential to the efficiency of the Navy, it is the practise to send all new recruits for this branch of the service to either of the two Navy Electrical Schools at the navy yards at Brooklyn, N. Y., and Mare Island (San Francisco), Cal. These schools provide instruction in two classes, general electrical work and radiotelegraphy. The length of the full course for both classes is eight months. Men specially proficient in the work pass thru this period in shorter time, depending on the knowledge and skill they show. All students, either recruits or men from the general service, may enter these schools at any time. In addition to the practical instruction imparted at the electrical and other naval trade schools and training stations, the men receive thruout their service aboard ship and elsewhere both academic and practical training to enable them to demonstrate their ability and to advance in their chosen vocation.

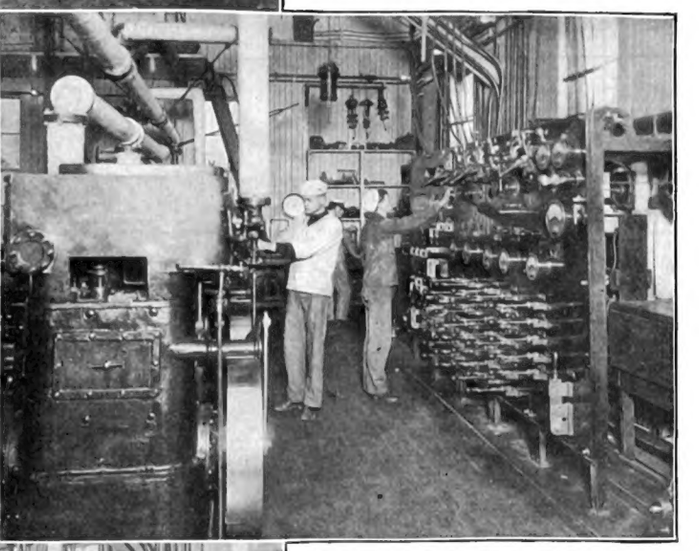
In order that a recruit may enlist for the electrical branch, he must have a knowledge of either general electricity, or be an operator of the Morse telegraph code or have sufficient foundation in radiotelegraphy to be competent to keep up with the class at the school. Electricians (general) must know the names and uses of the various parts of the dynamo and dynamo-driving engines and must be familiar with the ordinary types of switchboards and methods of wiring. Applicants for both classes must be able to write legibly, must understand elementary arithmetic and must be between the ages of 18 and 25. All applicants must be citizens of the United States, either native or fully naturalized.

Recruits meeting these requirements are immediately transferred to the electrical school, where the course of instruction comprises machine-shop work,

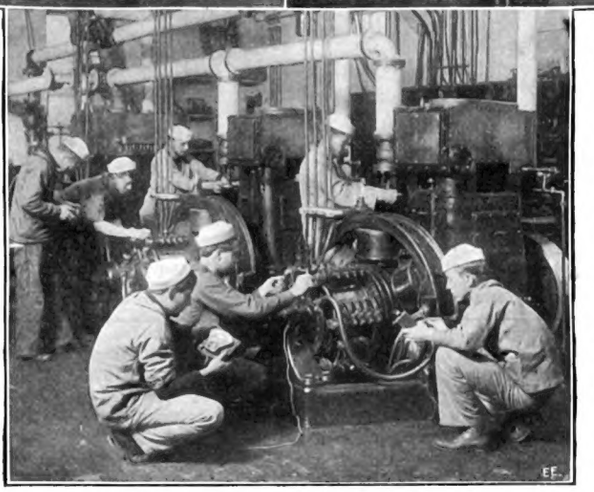
(*Continued on page* 142)







Another View of the Electrical School at Mare Island, Calif., Class Receiving Instruction in Electrical Appliances, Including Electric Searchlights.



Top:—View in Navy School, New York, Class in Interior Communication and Ship Control Apparatus. Below:—Testing Dynamos and Motors.

Uncle Sam's Naval Men Receiving Training in the Operation of Electric Generators in the Navy School at Mare Island, Calif.

Talking Motion Pictures Via Wireless

MANY of us have no doubt witnessed an exhibition of talking motion pictures, and numerous patents have been taken out on some very elaborate schemes intended to improve the efficiency of the apparatus involved in recording and reproducing the voice, as well as the figures of photoplay productions.

One of the most novel ideas devised toward accomplishing this purpose is outlined in a recent patent awarded to William B. Vansize, of Brooklyn, N. Y. The accompanying illustration by our artist shows how the inventor proposes to utilize and apply the art of radio communication to the recording and reproduction of talking motion pictures. In the first place, the studio stage is fitted with a metal floor, such as one covered with tin or sheet iron. This may be painted so as to give the effect of tile or carpet, and may have a few rugs scattered about to give an artistic stage setting. The small insert illustration shows how the inventor proposes to have each actor actually personify "a walking wireless station." In brief, each actor carries a complete wireless transmitting system on his person. When the actor speaks, the voice waves affect a supersensitive microphone hidden inside the coat or in the bodice, in the case of a woman. This microphone is connected to some form of miniature wireless transmitting apparatus, such as an *Oscillion* or vacuum bulb generator of radio currents. The voice fluctuations are caused to vary the current developed by the Oscillion, and these fluctuating, high frequency oscillations corresponding of course to the voice, are radiated thru a *ground* wire leading to metal plates (and points if necessary) on the heels of the actors, as shown, and also thru a miniature antenna comprising a series of tin-foil leaves which are sewn in the clothing in the manner indicated in the accompanying illustration. The radio apparatus is carried in the clothing, and the weight of each part distributed in the best manner possible. As will be noted the batteries are placed somewhat differently in the case of a lady, as compared to a man.

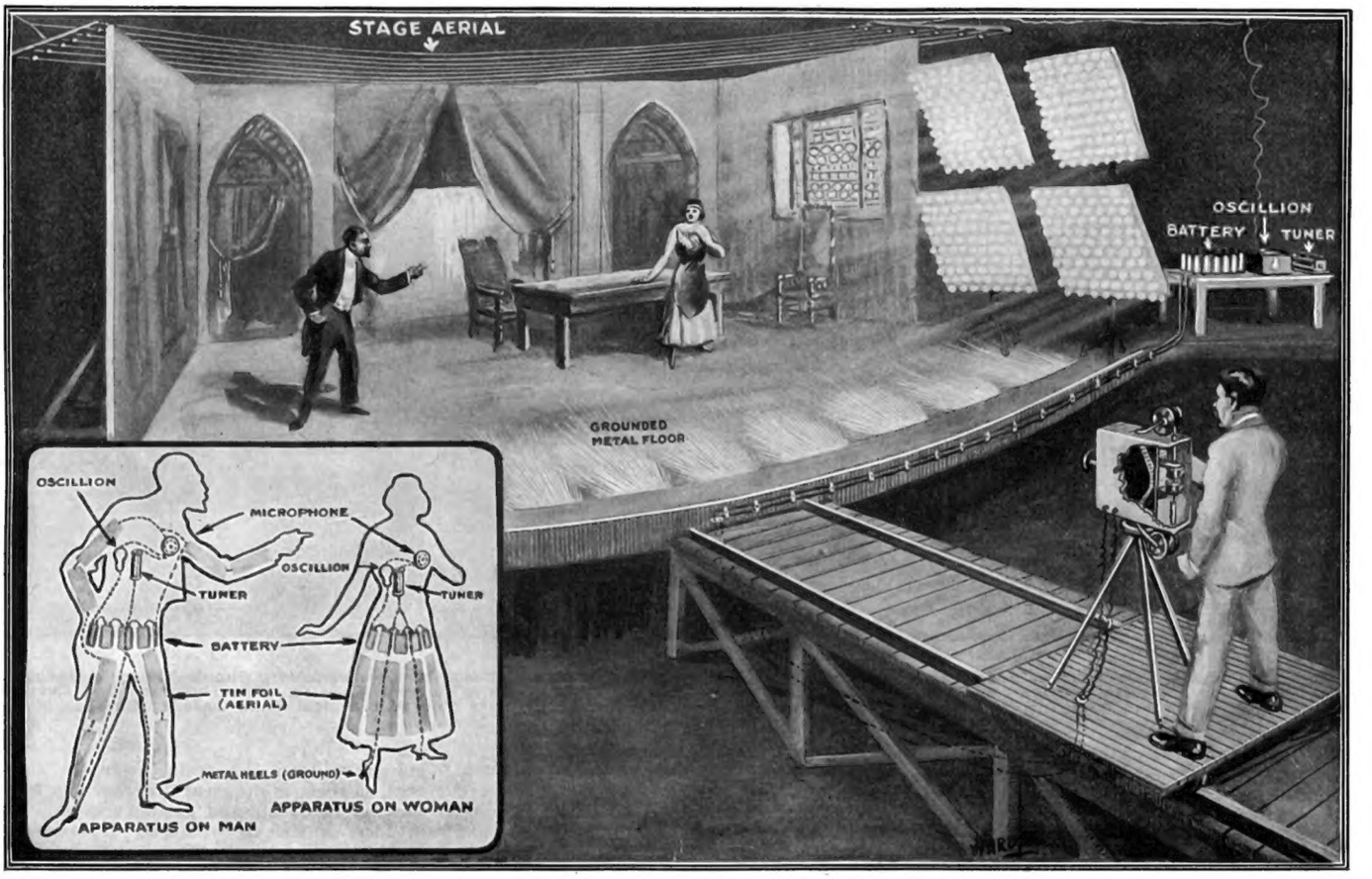
Thus far we see that whenever the actors speak, that they will be radiating wireless telephone currents, and these are intercepted or picked up by a larger radio antenna erected back of or just above the scenic settings of the studio stage in the manner illustrated. The stage antenna is connected up thru suitable tuning coils, with an oscillation or vacuum bulb device, which is used in this case as a detector and amplifier of the received radio-telephonic currents.

Now we have the actor's voice radiated by wireless from his own person, thence propagated thru space by etheric waves, and finally, we have them coming in thru the receiving circuit of the stationary radio detector. The secondary or auditory circuit of the detector and amplifier is connected with the recording electro-magnets of a Poulsen telegraphone, mounted intact on the motion picture camera which is recording the scene photographically. Thus, as the photographer turns the handle on the motion picture camera, he not only records the physical movements of the actors, but simultaneously he also obtains a corresponding record of their voices on the moving steel wire of the telegraphone, which has been explained in detail in previous issues of this journal.

In brief, the telegraphone operates upon the principle that if a moving steel wire is past by the pole of an electro-magnet thru which electrical voice currents are circulating, then there will be *local magnetizations* set up in the steel wire corresponding to the voice fluctuations. If then we afterward pass this steel wire under another electro-magnet, the coil of which is connected to a telephone receiver, we can then hear the voice reproduced.

The great problem confronting all inventors who take up talking motion picture work is to accurately and practically synchronize the motion picture voice with the voice of the actor. This is the most important problem, and by means of this wireless telephonic arrangement, as proposed by Mr. Vansize, it seems that it should become a simple matter to readily accomplish the purpose intended, viz., to record and reproduce faithfully a talking motion picture, and one in which the actors' lips will not be moving about ten seconds after the voice is heard or vice versa.

In practise a number of loud-speaking telephones are scattered about the moving picture theatre, and as the operator cranks his machine, the telegraphone wire is unreeled at exactly the same speed. The impulses from the recorded telegraphone wire now are used to operate the loud talkers about the house, with the result that the audience sees *and hears* the actors in a truly remarkable manner.



The One Great Problem in "Talking" Motion Pictures Lies in the Difficulty of Simultaneously Recording the Voice and the Scene. A New Method of Accomplishing This End Is Illustrated Here. Each Actor Carries a Radio-Telephone Transmitter on His Person. His Wireless Love and Other Speeches Are Intercepted by a Stage Antenna, Connected to a Radio Receiving Set. This Set Is Connected to a Telegraphone Joined Mechanically to the Motion Picture Camera. Thus Synchronism Between Voice and Picture Is Established.

Electricity and Water to Run Our Autos

GASOLINE forms the nucleus of power in practically all automobile engines of the present day, and many inventors and chemists have expended considerable energy and money in an effort to find a satisfactory substitute for this all-important commodity, which has been rapidly and constantly increasing in cost. One of the latest attempts in this direction is that of Mr. Ernest E. Punches, who hails from Detroit, Michigan.

"Give me a suitable tank containing a set of plates submerged in water and a source of electric current, and I will drive your automobile engine without any gasoline whatsoever at reduced cost," says this sanguine inventor.

The secret of this remarkable invention lies in the fact that if an electric current is past between two plates submerged in water, it decomposes the water, evolving two gases, *oxygen* and *hydrogen*; the oxygen accruing from this process is liberated, while the hydrogen is collected and when suitably mixed with a proper amount of air, it forms a highly explosive mixture when ignited in the automobile engine cylinder.

The accompanying illustration shows how the proposed water-electric gas-generating plant would be fitted to a motor-car, the special dynamo together with the decomposing chamber and gas storage tank being placed with the engine under the same bonnet. The small Unipolar type dynamo is connected by suitable gears or driving chain to the timing gear on the crank shaft of the engine, and supplies a low voltage direct current. This current is past thru the electrolytic cell shown in the illustration, alternate plates being charged positively and negatively. The plates are preferably perforated so as to promote circulation in the gas-generating cell, and by the close arrangement of the positively and negatively charged electrodes, the gas generation is both rapid and efficient.

As before mentioned the oxygen is liberated by suitable automatic valves, and the hydrogen is retained and past thru a mixing valve, similar to the usual carburetor used on all gasoline engines and which can be controlled from the driver's seat, following the standard practise in motor-car equipment. A suitable quantity of air is taken in thru the mixing valve, and which, when combined with the proper quantity of hydrogen, forms a highly explosive gaseous compound. When this is fed into the engine cylinders and ignited by an electric spark, it produces a force many times more powerful than that obtained when gasoline vapor is used. Some of the hydrogen gas produced by the electrolytic cell (decomposition of water) is stored in a suitable tank under pressure, which makes it available for starting the car and emergency. The entire combination unit fits the carburetor side of the engine and is supported by the former manifold holding means and also by the frame of the auto chassis. It has been found by Mr. Punches from trial and also by calculation, that the hydrogen gas-generating outfit here described, and which it is proposed to substitute for gasoline, will require up to 5 per cent of the horse-power developed by the engine, this 5 per cent of the total engine horse-power being used to drive the decomposing current dynamo.

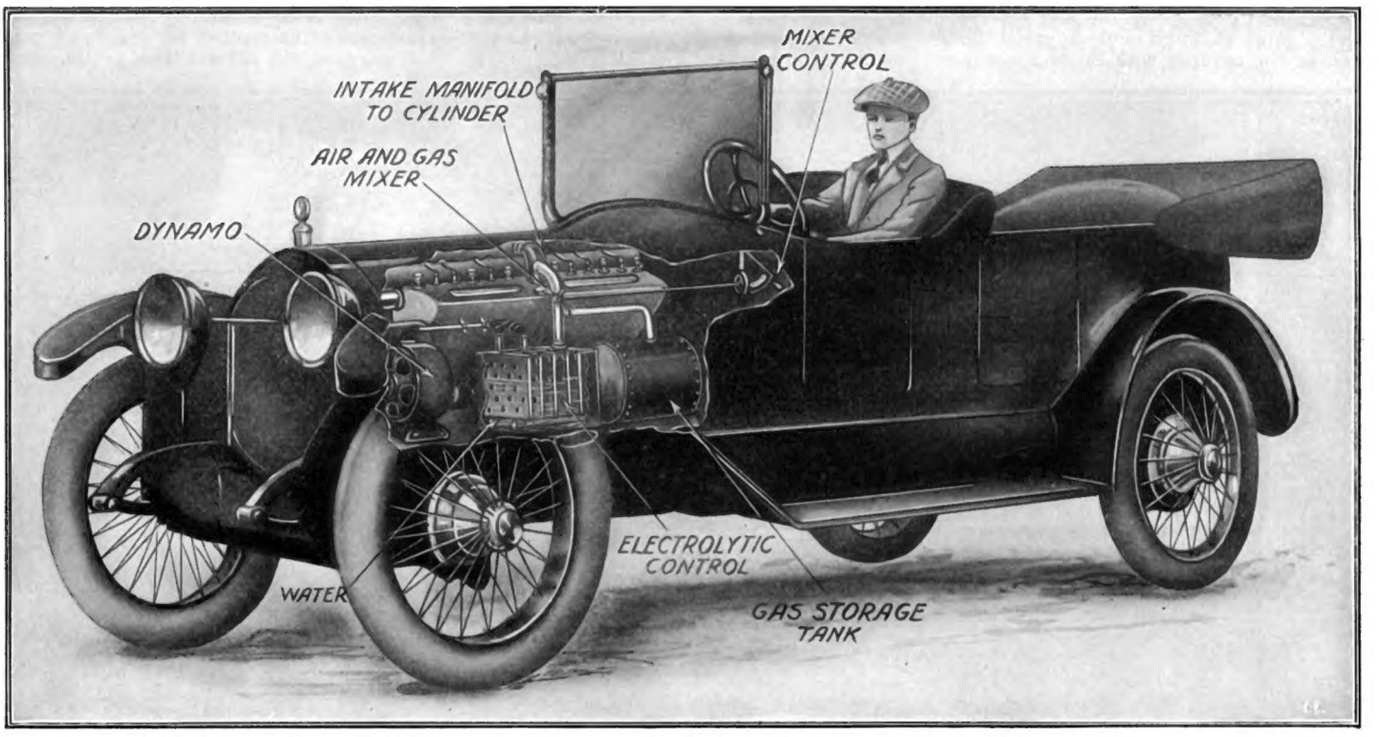
There are 1,257.52 cubic feet of hydrogen gas in one cubic foot of water, the gas at atmospheric pressure, zero degree Centigrade, and it will require 1,728 watts of electricity to decompose a cubic foot of water in one hour. Compare this with the following data, obtained from a Chalmers Motor Car Company engineer:—

The maximum revolutions of the Chalmers motor is 3,000 per minute under full load. The motor develops 45 h.p. on an average at this speed, and under full load, with a well worked in motor. The suction displacement per revolution is 244/2 equals 112 cubic inches; equals .0648 cubic feet. Then at 3,000 revolutions per minute and assuming 100 per cent volumetric efficiency, the number of cubic feet drawn into the motor per minute is 3,000 times .0648, or 194.5, and 60 times 194.5, or 11,670, is the number of cubic feet drawn into the motor, of mixture each hour, running at maximum speed and under full load.

The gasoline entering into that mixture is 7 per cent by weight, and the amount by volume will not depart far from the 7 per cent, as there is no great difference between the weight of air and gasoline vapor. So, in face of the fact that an explosion of hydrogen in a pure state, when mixed with air, is a *thousand times* as powerful, as is the same per cent of gasoline vapor and air, we shall be way above in figuring a 10 per cent mixture of hydrogen gas with air. As 10 per cent of 11,670 is 1,167, the number of cubic feet of hydrogen, we must generate in an hour. Bearing in mind that there are 1,257.52 cubic feet of hydrogen in a cubic foot of water, and that 1,728 watts will decompose the cubic foot of water in an hour, and also that 746 into 1,728 goes about 2¼ times, it is apparent that we will generate 90.52 cubic feet of gas per hour more than the Chalmers motor can use at maximum speed, and under full load, taking *less than 5 per cent of the* 45 *h.p.* to drive the decomposing current generator. The inventor has demonstrated his invention before the entire engineering staff of the Tecla Electrical Laboratory of Detroit, Michigan.

When it is understood that gasoline is simply a mechanical mixture of hydrogen and carbon gases and impurities, it will be seen that a mixture of pure hydrogen gas

(*Continued on page* 145)



A Detroit Genius Claims to Have Solved the "Gasoline Substitute" Problem for Automobiles. He Utilizes a Very Simple Electrical Phenomenon—That of "Electrolysis" or the Decomposition of Water by the Passage of An Electric Current Thru It. The Hydrogen Gas Evolved Is Mixed With Air and Past Into the Engine Cylinders. The Inventor States That It Is More Economical Than Gasoline Because of the Higher Explosive Value of the Hydrogen-Air Mixture.

OPTICAL DEVICE THAT RIVALS TELESCOPE IN STUDYING THE HEAVENS.

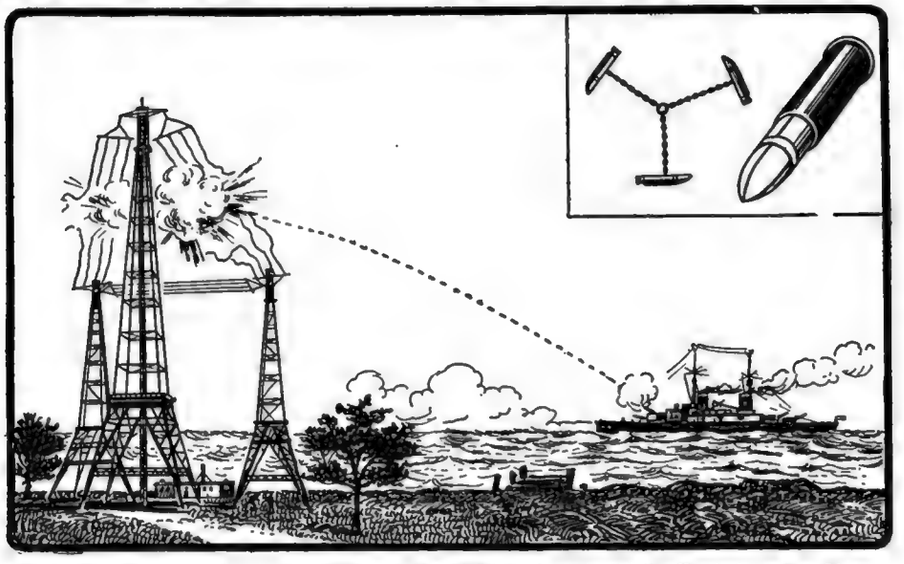
An optical device, which is said to rival if not surpass the telescope in revealing the mysteries of the heavenly bodies was exhibited at a recent meeting of the American Society of Mechanical Engineers in New York. The invention was exhibited by Dr. John A. Brashear, the grand old man of American astronomy, of Pittsburgh.

"This instrument is called a diffracting grating," said Doctor Brashear, as he showed what looked like a rectangular piece of metal about 2 by 4 inches long that changed colors under the electric lights. "On the plane surface of this polished plate, made accurate to one-tenth of a light wave, or within one-forty-five-thousandth of an inch, are ruled more than 45,000 lines between which there is no greater error than one-two-millionth of an inch.

"With this delicate piece of apparatus, made possible, first by rigorous scientific research; second, by the skill of the artisan; third, by a knowledge of a vigorous care to avoid temperature changes, and, fourth, by the accuracy of the mechanism, the astrophysicist has been able to tell the composition, temperature and distance of the stars."

REVIVING THE CHAIN SHOT TO DESTROY RADIO AND OTHER AERIAL WIRES.

An American inventor has recently proposed that the military and naval authorities revive a relic of warfare which was in vogue many years ago—this is nothing less than the generally well-known *chain shot*. In our grandfathers' and great-grandfathers' day it was considered quite a nifty idea to tie one or more cannon balls together with an iron chain—thus, the name *chain shot*. The accompanying illustration shows a clever form of split projectile composed of three or more pieces divided in the manner shown, so that by means of a time fuse or other arrangement, these pieces would fly thru the air as a solid projectile, and at the critical moment would explode and describe a path of considerable width thru the atmosphere, and proving, it would seem, of decided efficiency in destroying radio antennae, and all other elevated wire structures such as telegraph and telephone wires, power transmission circuits, et cetera.



A New War Invention Is a Split "Chain Shell" That Automatically Explodes at a Given Range. It Should Prove Particularly Valuable In Destroying Radio Antennae and Other Wire Structures.

GOVERNMENT TAKES OVER MARCONI STATIONS.

The U. S. Government has availed itself of the offer of the Marconi Wireless Telegraph Company of America, placing its staff and stations at its service and has taken over for the period of the war not only the Marconi stations but all other radio stations for military purposes. The eligible operators will be enrolled in the government service. Stations not required will be closed. The trans-Pacific stations will continue handling commercial traffic, but under government supervision. No ship traffic will be permitted on the Atlantic and Gulf Coasts and the Great Lakes excepting for the government, but it will continue for the present on the Pacific. Trans-Atlantic traffic via Glace Bay will not be disturbed. The Director of Naval Communications, Lieutenant Commander Todd, at Washington, will have charge of stations operated by the government. Enrollments will be made by commands of naval districts.

To Counteract the Poisonous Gas Fumes Blown Toward European Trench Rescuers Who Are Called Upon to Go Forth and Carry Prostrate Soldiers From Their Positions, They Have Guarded Themselves Against Being Overcome by a Novel Telephone Appliance Attached to the Gas Defying Equipment.

EUROPEAN SOLDIERS USE GAS MASKS FITTED WITH TELEPHONES.

The accompanying illustration shows in a marked manner one of the peculiar and particularly effective scientific devices brought out by the great European war.

Needless to say this war of all wars has developed hundreds, even thousands, of new inventions of every conceivable character. First the Germans invented the gas apparatus by which they attempt to overcome their enemies in the trenches with clouds of noxious fumes, and here we have the answer to this challenge in the form of a *gas mask* or helmets, which are worn by the members of the trench rescue brigade, who are called upon to go forth and carry prostrate soldiers from their positions where they may have fallen between the trenches, when overcome by the gas cloud. Each gas helmet and mask is fitted with a novel and specially designed telephone outfit, properly connected to a trailing wire leading back to the trench, so that the rescuers are able to telephone for aid without removing their helmets or apparatus.

GOVERNMENT RADIO BILL GOES OVER.

House leaders at Washington have decided definitely not to pass at this session the Administration bill for permanent Government dictatorship over wireless apparatus, unless the President specifically requests it.

It was learned that the House Merchant Marine Committee believes the President already has power enough over radio stations to prevent their use in time of war.

The principal feature of the bill is its provision for eventual Government ownership of radio companies. This feature is not considered by the committee to be strictly war legislation.

Shooting With Electricity

By H. Gernsback

YEARS ago, when the New York City elevated lines changed from steam to electricity, one of the elevated trains caught fire. An alarm was promptly turned in and in due time the firemen were on the spot. The stream from the high-pressure hose was played on the cars, and to prevent the fire from reaching the wooden structure on which the rails rested, as well as the wooden foot path, one of the firemen of necessity directed his stream on the third rail.

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The stars are not intended to indicate what happened and what that poor fireman saw; rather they are meant to illustrate how long he remained unconscious. As a matter of fact the man was almost electrocuted. Since that time firemen do not fight elevated fires unless they are assured that the power has been turned off.

Now, the N. Y. Elevated Lines only carry 500 volts direct current, but this pressure is sufficient to pass from the third rail line, then to the water of the fire hose, and from there into the metallic nozzle held by the fireman. Altho ordinary hydrant water is a poor conductor, a 500-volt current nevertheless finds but little trouble in passing thru the stream of water and thence thru the body of the fireman, with the result that he is knocked unconscious. If the stream had been sea (salt) water, there remains little doubt but that the man would have been electrocuted instantly.

Upon this principle the writer has based his idea of *shooting electricity* at an enemy, impracticable as the scheme sounds at first thought. Many murderous ideas, of course, have been advanced for trench warfare, the German *Flammen Werfer*, whereby liquid fire is sprayed upon the enemy, being a parallel to the writer's scheme. While shooting flames over a distance of 50 feet or more has not proven a wonderful success, nevertheless the idea seems to have some merits. And if the Germans can shoot flames at us, why can't we return the compliment by shooting electricity at them? One is as easy as the other, with a few points in favor of the latter, it would seem.

HAVE you ever stopt to consider that a fireman does not dare to let a stream of water from a nozzle strike an electric wire, carrying any appreciable potential, say a thousand volts or more, as he may be electrocuted. Proverbially speaking, it is a poor rule that will not work both ways. Hence we have the unique proposal by Mr. H. Gernsback, that we charge the enemy with highly electrified streams of acidulated water under high pressure. This unusual invention is not intended as a substitute for guns, but to supplement them. It represents one answer to the German's "Flammen Werfer"—Liquid fire.

Briefly, the idea is as follows: Strapt to a soldier's back is a lead-lined metal tank carrying a solution of diluted sulfuric acid of about 1200° specific gravity. (A solution of chlorid of zinc or even ordinary salt water could be used.) By turning a knob on the outside of the tank a small quantity of zinc or iron filings is thrown into the acid and immediately hydrogen gas is evolved, causing considerable pressure inside of the tank. This causes the acid to be forced out thru the hose attached to the tank and from the hose the acid passes thru the long nozzle carried by the soldier. The acid leaves in a fine stream, less than a quarter of an inch in diameter, and with a fairly calm atmosphere, it should carry from 75 to 100 feet. For most purposes, 50 feet however, will probably be found sufficient.

Now, back in the trench (or behind the lines) there is a 10-H.P. gas engine driving a 5- to 8-H.P. Alternating Current Generator. The latter is connected to a step-up transformer delivering from 10,000 to 15,000 volts. A thin but extremely well insulated cable connects with the nozzle carried by the soldier. This cable is connected to one side of the transformer; the other pole is *grounded* to earth. If now the stream hits an enemy soldier (who is not insulated from the ground), the high-tension current passing thru the stream of highly conductive acid, runs thru the man's body and thence thru the earth, back to the transformer. In this case he probably will be electrocuted or else knocked senseless by the powerful current. Even standing on a piece of dry wood or a stone will not help him, for the acid running down from his uniform will turn the wood or the stone into an excellent conductor and the enemy will almost certainly be rendered unconscious. Probably the most efficient way of utilizing the new scheme will be found in directing the charged stream at a machine gun. The second the stream hits the metallic portion of the gun, the operators will be knocked unconscious or will even be killed. It is also understood that the entire electrocuting outfit, gasoline engine, dynamo, transformer, acid tank and all the rest of the equipment could be placed in an armored car. In that case, the operators would not be exposed to machine gun fire.

When used by the soldier, however, it is self-evident that his equipment must be such that he himself will not be electrocuted. To that effect he wears a special "high-tension" rubber shoe, capable of withstanding 20,000 volts.* Then too he uses "high-tension" rubber gloves, and in addi-

The Germans Invented "Liquid Fire" With Which to Destroy the Enemy. Here Is An American Invention—Shooting the Enemy With Piercing, High-Pressure Acid-Water Streams Charged to An Electric Potential of 15,000 Volts. Trench Gasoline Engine, Electric Plants and Transformers Supply the Necessary Power. The Nozzles Are Heavily Insulated and the Soldiers Wear Heavy Rubber Shoes As Well As Gloves and Masks.

The Best Way to Aid the President

By HOWARD H. GROSS,
President Universal Military Training League

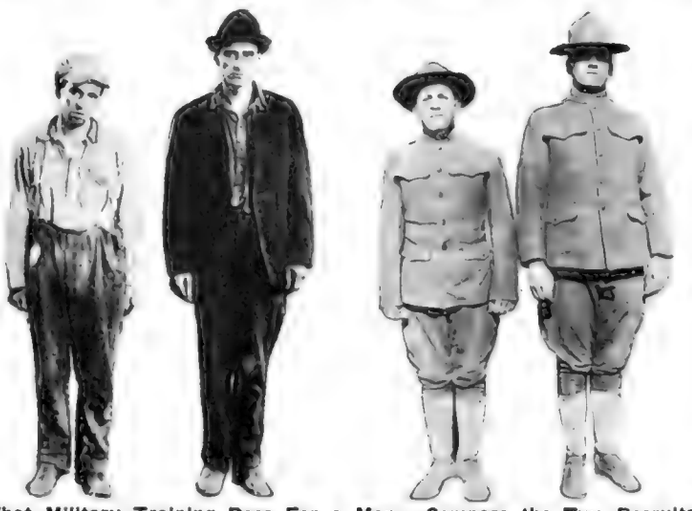
A FIXT military policy which will protect the nation and strengthen her manhood is the special need of the hour. Each passing day demonstrates this. This League and its sponsors believe that in universal military training lies the nation's chief hope. They therefore urge two things:

First and foremost: Stand behind President Wilson in every way. He is bearing a tremendous burden. Assist him in all emergency measures, whether financial, military or economic.

Second: Use every influence to impress upon our Senators and Representatives in Congress that emergency war measures now pending will not solve our military needs except *temporarily*. They may carry the country along for the present, but they will not do for the future. The most democratic program as a *fixt military policy* for the United States is that of *universal compulsory military training*. It treats all alike, makes use of young men before they reach the age where their earning capacity is high and when they are yet unmarried, and gives them six months' intensive military training. Then it sends them back to work. These trained youth will form the backbone of a great, democratic citizen army. This is the only definite, simple and patriotic plan that will make America safe and ready.

I earnestly hope that every American will stand by President Wilson and the Government officials who, with the President, are bearing a gigantic responsibility. I have just returned from the national capital and I know and sense in a measure the weight that is taxing our silent and conservative Chief Executive. It would be shameful to see his plans for meeting this crisis defeated. Therefore, as should all citizens, I bespeak general co-operation with President Wilson in these mighty works.

They are emergency measures, as he has said. This universal military training plan is supplementary to the President's emergency measures. It goes further and will last longer. While he is doing all that he can do safely to pilot the ship of state thru the eddies just ahead, I ask all patriotic citizens not only to strengthen his arm in this effort, but to aid the nation as a whole in supplementing the President's labors by the establishment of universal military and naval training.



What Military Training Does For a Man. Compare the Two Recruits on the Left With the Two Erect Figures on the Right. They Are the "Same Men," Photographed Before and After Being Trained for Five Months in the U. S. Army.

The benefits resulting from such a democratic plan for raising an army in emergencies cannot be over-estimated. The last few weeks have shown how weak and futile other devices have been. The *volunteer* system is unfair, and because it is so thousands of young men who are as patriotic and loyal as the best in the land will not offer their services. They have come to realize that the strong, highest types of manhood go forward while the cowards and slackers only too gladly stay at home. The best blood goes to the front while the unpatriotic rejoice in secret in the opportunity to remain safe and sound at home, pile up money and have a good time.

Such a false premium upon patriotism is not only disgraceful in a national military program, but it is decidedly uneconomical and wasteful. In nine cases out of ten the slackers are able-bodied, and under proper tutelage would make good soldiers, while the patriotic fellows who rush to the colors are the sort who are needed most to man the commercial and financial craft of the nation. The best brains will go into the ranks as privates and leave the sluggards at home to conduct the nation's affairs. This is fundamentally bad in a democracy.

Selective conscription no doubt may be necessary at times, but it never will be popular. *Universal military training*, on the other hand, is, thru its very universality, plain, simple democracy. It says that all having the blessings of our institutions should, in time of need, contribute their aid to defending these institutions. It says, further, that the untrained soldier is so much "cannon fodder," and that the chances of the trained lad returning home in health from war are about three times greater than the untrained boy's.

Therefore, in universal military training, the secret of our general military and naval needs for today, tomorrow and All Time is found.

The Universal Military Training League makes special appeal to the people of the country to write their Congressmen to back President Wilson in all his emergency measures and to eradicate forever the doubt, uncertainty and weaknesses of present muddled military policy by establishing in law a fixt plan for universal, compulsory military training and service.

Stand by your President and strengthen your nation!

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tion to this the nozzle is heavily insulated from his hands by means of a special insulator, as grafically shown on our front cover. The tank of course must be well insulated by soft rubber pads from the back of the operator. Thus equipt he is in little danger of being shocked by the current.

In order to prevent the wind from driving his own acid spray against the operator's face, he is also equipt with a soft rubber mask, as illustrated on our front cover and on opposite page.

From a humanitarian standpoint, the scheme is far ahead of the German flame shooter; sulfuric acid of 1250° does not blind, nor does it destroy animal tissue, unless it remains in contact with it for a long period. Sprayed on the skin, but slightly itching results after a lapse of several minutes. On the other hand, the high-tension current kills either outright, or otherwise puts the enemy out of the fighting for the time being, with little bad after-effects. The acid, plus electricity, does not cause horrible burning wounds or burned off limbs as does the liquid flame.

As with all war-schemes, the wise ones will now ask the usual question: What happens, if the enemy too uses the electrocuting apparatus?

In answer the writer asks another question: What happens, if the enemy *too* uses liquid flames, or if the enemy *too* uses machine guns?

*This shoe was described on page 24, May, 1917, issue of this journal.

AUXILIARY SIGNAL CORPS UP-TO-DATE.

Perhaps the finest single auxiliary signal corps possest by any army has been given to the United States by the American Telephone and Telegraph Company. About 500 engineers already have been selected and some of them have been sworn into army service. The differences between government pay and their salaries with the telephone companies will be paid by the latter.

The corps will be made up of general plant and traffic engineers to plan, set up and operate telephone, telegraph and wireless plants. If the regular force of the army proves to be too small, men also will be provided to assist in the wireless work.

DATE OF ISSUE.—*As many of our readers have recently become unduly agitated as to when they could obtain* THE ELECTRICAL EXPERIMENTER, *we wish to state that the newsstands have the journal on sale between the fifteenth and the eighteenth of the month in the eastern part of the United States and about the twentieth of the month west of the Mississippi River. Our subscribers should be in possession of their copies at these dates. Kindly bear in mind, however, that publications are not handled with the same dispatch by the Post Office as a letter. For this reason delays are frequent, therefore kindly be patient and do not send us complaints as to non-arrival of your copy before the twenty-fifth of the month.*

Electricity's Aid to Women

Here We Have the Combination Electric Stove, Stript for Action—Said Action Being That of Frying Eggs. And They Do Say Electrified Eggs Taste the Best.

Cook by Wire—Without Fire. The Combination Electric Table Stove Shown Above Enables You to Fry Eggs, Broil Chops, Make Toast, Boil Water—Yes, and It May Even Be Used as an Oven.

Who Can Remember Ironing Day Without Wishing There Wasn't Any Such Animal. But All Is Changed. Behold the Electric Ironer That Really Does Wonderful Work at 4 Cents an Hour. Even the Chinaman Is Outdone.

Have You Ever Been Down South? If So, You Know "Waffles." Well Here's an Electric "Waffle Iron" That Makes Two Delicious and Geometrically Correct Waffles at One Time, Cooking Top and Bottom.

Do You Have to Polish Waxed Floors? This Back-Breaking Task Is Now Accomplished in a Short Time and in a Highly Efficient Manner, by the Electric Motor Floor-Polisher Shown.

And There's the Sewing Machine. An Electric Motor Drives It Merrily at Half a Cent an Hour. Press the Treadle and Control the Power.

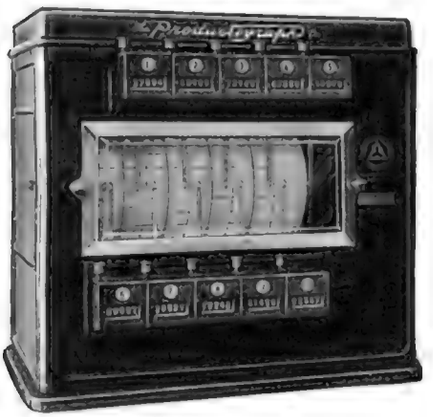
Remember the Fellow Who Told the Waiter the Steak Was Too Rare? Said the Waiter—"We Cook by Electricity." "Well, Give That Steak Another Shock," Said the Patron.

Electricity's Place In Business

ELECTRICITY SPELLS EFFICIENCY TO THE BOSS OF TO-DAY.

Efficiency has reached a very important rôle in modern industry where the manufacturer manifests a desire to obtain the maximum output of his plant with a minimum input—in other words—Efficiency. Various schemes have been promulgated in the direction of increasing efficiency in machinery and it was found that the best means which the manufacturer can employ to determine the efficient output of his plant is to note the actual productive power of the *individual* output of each machine and employee. Schemes were introduced for this purpose, but the defects encountered in them were numerous and most of which had to be abandoned for the purpose for which they were made.

The distinct need of an instrument for increasing the efficiency in productive plants grew more and more urgent, which caused a number of prominent engineers to study this rapidly growing problem. This work finally led to the development of an instrument called the *Productograph*, herewith illustrated and which has proved the solution to this absorbing problem. The introduction of this instrument was made possible by the application of electricity.



The Business End of the Electric "Productograph"—the Instrument that Keeps Tally on the Daily Output of Each Worker in Shops and Factories.

The first illustration shows the complete instrument which is stationed in the manager's or superintendent's office. It consists of a drum upon which a sheet of specially prepared paper is placed. Over this paper there are ten recording needle arms, which are actuated by electro-magnets; these are located within the cabinet. Each needle is directed over the proper section of the paper and each needle is electrically connected to a single machine, of which the productive efficiency is to be found. The sections of the paper are longitudinally divided into 24 equal parts corresponding to 24 hours. Each division is subdivided into minutes. The cylinder is rotated by means of an electric motor connected to a standard clock, operating a series of electrical contacts. Normally, when the needle arms are not acted on by the electro-magnet, which is connected to a special switch attached to the machine the record of which is to be obtained, a straight line is made and every time the machine is in operation it causes the switch to close the electrical circuit periodically, which operates the needle arm and this in turn traces a curve on the paper. If the machine stops for any reason, the indication on the paper shows this and immediately gives the owner visual indication of the fact. In addition to this equipment, an electro-magnetic counter is connected to the same circuit, which indicates the number of operations made by the machine. Thus, if this instrument is attached to a printing press, it will indicate exactly the number of printed sheets that the machine has made during a certain period. Each needle has its corresponding counting instrument and both are connected to a single switch. This particular instrument herewith shown is adaptable for ten machines.

The second photograph shows the adoption of this device in a clothing establishment, where it is used for checking up the number of coats made by each operative.

APPLYING PSYCHOLOGY WITH THE ELECTRIC "PSYCHOMETER."

The latest device for testing speed and quality of human thought is the "Psychometer," which is an electrical apparatus now being used in San Francisco, where it is being applied to accurately measure the degree of alertness in employees in industrial establishments, as well as general mental alertness in all vocations.

The Psychometer is operated by either alternating or direct current and may be attached to the baseboard electric light socket. The clockwork attachments and electrical connections are operated by pressing a simple telegraph key which is connected with the baseboard plug. The instrument is built in a grip and may be easily carried around. The readings are made by an electric light, which is mounted on the side of the small suit case. The instrument is an accurate gage of memory and measures speed and quality of thought to the fifth of a second, besides charting alertness and ability to react quickly in mechanical work and emergency situations.

Photo from Press Illustrating Service.

Prof. Münsterberg Claimed to Be Able to Select the "Best" Ship Captains, Locomotive Engineers, Aviators, Etc.—All by Psychology. Here We See the "Psychometer" Being Used to Test the Mental Alertness of San Francisco Factory Employees. The World Do Move.

Here We See a Portable "Productograph." Connected to Each Machine It Enables the Young Lady in the Foreground to Readily Keep an Exact Record of Each Employee's Output.

PROMINENT ELECTRICAL ENGINEER BECOMES ARMY MAN.

Appreciating the importance of securing the ability and training of the engineers of the country for use in national defense measures, President Wilson has appointed a number of prominent engineers in the country to positions in the army.

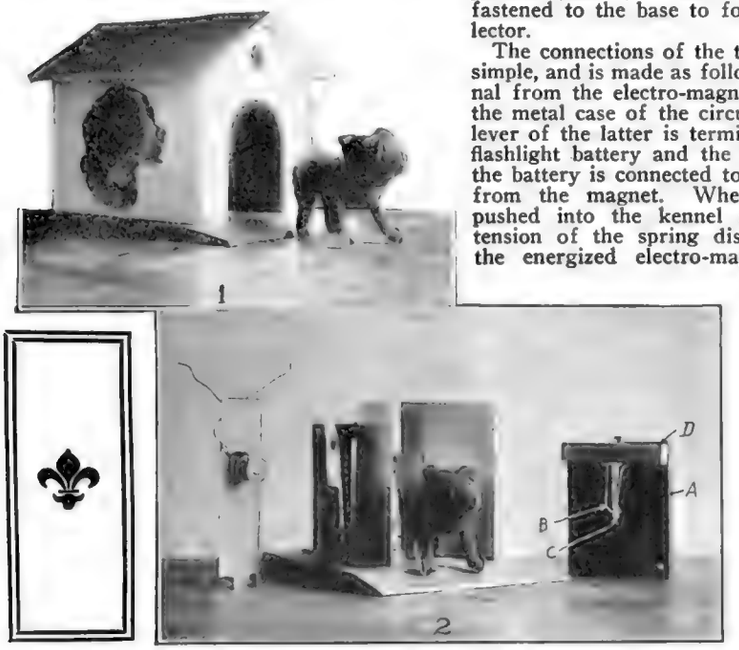
One of the appointments which will meet with the most hearty approval of the electrical engineering profession is that of Paul M. Lincoln, Commercial Engineer of the Westinghouse Electric & Mfg. Company, as Captain of the Engineer's Corps in the U. S. Army.

Announcement has just been made of this appointment together with a number of other prominent engineers.

Mr. Lincoln graduated from Ohio State University in 1892, and has for 24 years been associated with the Westinghouse Electric & Mfg. Company. He is a Past President of the American Institute of Electrical Engineers, and has always taken an active interest in the work of this association.

SOUND RELEASES TOY DOG FROM ITS KENNEL.

A very interesting toy has recently been introduced in the toy market and which is herewith illustrated. A similar toy was described in our June, 1916, issue, but the present one is of a simpler construction. The "Wireless Pup," as it is called, is shown in Fig. 1; this shows the dog standing outside of his kennel. The sensitive circuit-breaker and other apparatus are all placed within the kennel. This interesting and most amusing toy was originated and perfected by Mr. Christian Berger, a prominent physicist who has devoted most of his attention to developing scientific toys.



Two Views of New "Wireless Pup" That Springs Out of His Kennel at the Sound of a Whistle, the Voice, or the Clap of the Hands.

The operation of this toy depends upon the opening of a delicate circuit-breaker by sounding a whistle or by the production of any other sound. This circuit-breaker is connected in series with a battery and electro-magnet, which acts upon a flat metallic disc. This disc or plate is so arranged that when it is released by the electro-magnet, it will strike the dog, pushing him out of the kennel. The electrical circuit is only made when the flat disc is prest against the core of the magnet, which holds the same to itself until the circuit-breaker is excited by sound waves.

A detail photograph showing the various parts used in making up this toy is given at Fig. 2. The holding electro-magnet is seen at the left and consists of a core 5/8-inch in length and 1/4-inch in diameter; two insulated end pieces are placed on each end and the coil is wound with No. 30 B. & S. enameled wire. The complete magnet is mounted on an iron frame, as shown. The small projection on top of the magnet is used to strengthen the magnetic pull of the electro-magnet. The release or discharge disc is fastened to this frame in such a way as to permit the disc to spring forward when released by the electro-magnet. The complete arrangement is then mounted on a wooden base.

The sound operated circuit-breaker is seen on the right. This consists of a rectangular metal box A, in which the sensitive parts are placed. The horizontal lever B is made from a No. 18 bare wire, bent as shown; the ends are pivoted on a block of wood, the dimensions of which are those of the interior of the metal case. The lower part of the lever B, should touch lightly the metal surface of the case A, at point C. Of course this must be within the case. The complete circuit-breaker is placed behind the electro-magnet frame, as noted in the assembled apparatus (center). Two sheets of metal are fastened to the base to form a sound collector.

The connections of the toy "pup" is very simple, and is made as follows: One terminal from the electro-magnet is linked with the metal case of the circuit-breaker. The lever of the latter is terminated in a small flashlight battery and the opposite side of the battery is connected to the second lead from the magnet. When the "pup" is pushed into the kennel and against the tension of the spring disc, it is held by the energized electro-magnet. Then by making a sound such as by blowing a whistle, the circuit-breaker will be spurred up, thus opening momentarily the circuit which releases the spring disc, bouncing Mr. "Fido" out of the kennel.

A trap drummer has discovered that electric lights installed inside his drums keep the moisture out and makes the drumheads tight.

St. Patrick's Cathedral of Norwich, Conn., is lighted with six electric projector units, which bring out the chancel arch and altar in beautiful relief.

Buttons!

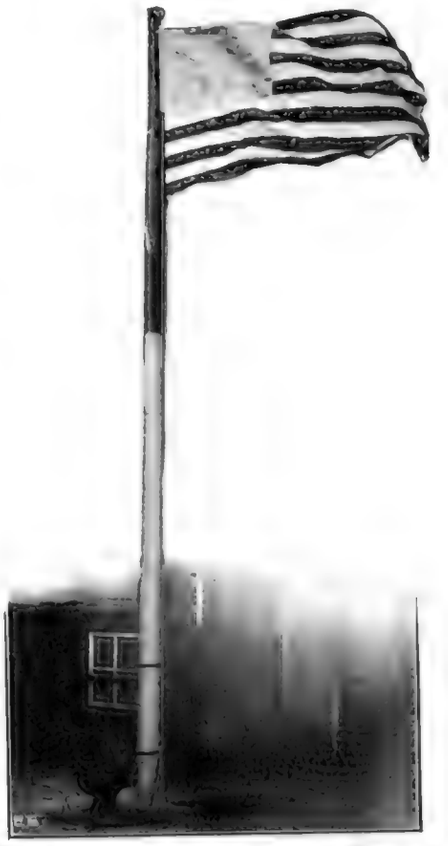
"Speakin' o' buttons," said Uncle Zeke,
Shifting his quid to the other cheek,
"Speakin' o' buttons, I want to say,
There's the beatenest kind, down New York way;
'Twaz in one o' them big hotels, by jing,
That melts your dollars like snow in spring,
That I see them buttons, along the wall,
Right in a bunch; mebbee six in all.
'Twas gittin' too dark to see outdoors,
An' I got to foolin' with them because
There wuzn't much else fer me to do,

When—Jiminy crickets; before I knew,
I thought I had sot the house afire,
And I yelled as loud as our old town crier,
Till the folks came runnin', licketty cut!
I told them what wuz the matter, but
They didn't do nothin' but laffe an' joke,
'Bout that dad blamed button I tried to poke,
Then they showed me just how it worked, an' gee!
'Twas the cutest thing I ever see.
Why, it made a blaze like a bonfire done!
They said 'twuz invented by Eddy's son;
I don't know just who Ed is, but say,
His *son* is the feller that gits *my* pay!"

By Pauline Frances Camp.

AN ELECTRIC SELF-WAVING FLAG.

One of the most talked of features at the Electric Railway Convention at Atlantic City, N. J., was a waving flag which fluttered from a 27-foot flagstaff in front of the General Electric Company's booth inside the spacious convention hall. Not a breath of air was stirring, yet the flag stood out on the pole as if a thirty-mile gale was blowing. The flag pole was of ordinary dimension and there was nothing visible to betray the source of the breeze. The base of the pole was surrounded with banked palms. It was only when visitors got very close to it that the scarcely audible hum of a motor gave a clue to the source of the breeze.



This Flag Always Waves, Whether There Is a Breeze or Not. A Motor-driven Blower Pumps a Strong Draft of Air Up Thru the Hollow Mast, Which Accounts for the Mysterious Effect Obtained.

The whole device is really quite simple in construction and easily explained, for the flagpole is a metal tube and an electric blower at the base shoots a strong current of air thru the flagstaff. The air escapes thru perforations in the top of the flagpole and imparts a waving motion to the flag.

PROCESS FOR DRAWING LAMP FILAMENTS.

A process for cold-drawn metallic filaments has recently been patented by Mr. K. Nishimoto, of Tokyo. Forming at first a consolidated stick of mixture of tungsten and a small proportion of thorium, an alloy is obtained by uniformly heating the mixture at a sintering temperature and then gradually keeping its temperature at dull red heat. The consolidated stick is then subjected to repeated hammering or rolling until it becomes so ductile that it may be hammered into bars, rolled into sheets or drawn thru dies into wires, much like the metals which are commonly treated in this manner at ordinary temperature.

Powerful Hydro-Electric Salvage Apparatus to Raise Sunken Ships

By H. Winfield Secor, Assoc. A. I. E. E.

POSSIBLY more than one enterprising inventor of to-day has conjectured on the problem of raising some, if not all, of the hundreds of torpedoed steamers which lie scattered along the European coast in comparatively shallow water, not to mention the many sunken ships lying within the coast boundaries of our own country. It is not often that we hear of a sunken ship being floated and brought into dry-dock for the reason that the cost of performing such an engineering feat is generally prohibitive, and also in many instances, the problem of raising the sunken vessel at all has practically been beyond solution.

Now comes an American inventor, of Swedish birth, one Mr. Carl Linquist of New York, and formerly of the Swedish Navy, who has devised a remarkable new scheme for raising sunken ships of no matter what size, as long as they do not lie in too great a depth of water, and which idea he intends commercializing at an early date.

It goes without saying that if Mr. Linquist's idea, as outlined herewith, proves feasible and successful, that he will find plenty of work for several years to come.

After the War There Will Be Thousands of Vessels Lying on the Oceans' Beds. If Only a Fraction of These Can Be Floated and Repaired, Think What It Will Mean to Commerce. A New Invention Intended to Accomplish This Purpose Is Illustrated Here and Involves the Use of Two or More Powerful Cylinders Which, as They Are Emptied of Water and Made More and More Buoyant, Finally Exert Sufficient Upward Pull on the Cables to Lift the Vessel.

The inventor's idea involves the use of two or more telescopic cylinders or chambers as shown in the accompanying illustration, which are attached thru massive universal joints at their bases to the large horizontal submerging chambers or "feet" which rest on the bed of the ocean or lake. In the first place, it is of course paramount that the exact location of the sunken vessel be known. Having this information, the salvage expedition sets out from the nearest port with the necessary number of these large collapsible cylinders with their attached base members (or "Forts" as their inventor calls them). The vertical cylinders shown lie horizontally, and as do also the base members, which are made to float, and the vertical and horizontal sections double up like a jack-knife, permitting the several units of this equipment to be towed by tug boats to the scene of the wreck.

The present plans of the inventor consider that salvage operations may be successfully carried on for any size vessel in depths of water up to three hundred feet, and where necessary four to eight or even more of the raising cylinders are employed, placing an equal number of them on each side of the sunken ship.

Supposing that several units of the salvage equipment are ready and floated to the position where they are to be used, the engineers then proceed to fill the base member with water causing it to sink. As it does so, the upright cylinder naturally assumes a vertical position, and moreover the base member obtains a very powerful hold on the bed of the ocean or harbor by "sand-suction," besides the heavy water pressure bearing down on its outer surface. A number of strong cables are let down in the water, and with the aid of an operator inside the inner pontoon who directs the work, these cables are swept under the hull of the sunken vessel. When all of the cables have been properly placed, the engineers are ready to begin operations for raising the wreck. Here is where the remarkable genius of Mr. Linquist comes into play, for he does not attempt to raise the ship by means of steam or any other form of engine. He has called upon Dame Nature herself to furnish the wherewithal to raise any ship, no matter what the size. In brief, what he does is this:—

The upper telescopic and movable cylinders rising within the vertical floating chambers and guides, they are allowed to fill with water from the ocean itself, and as will be seen these will then sink to any required depth. When they have submerged until their upper structure is just above the water, the valves are closed, and by means of powerful electric pumps (in case the operations take place a considerable distance from shore, gasoline engine-driven pumps are available), the water within the movable upper cylinders is rapidly pumped out. But a moment's reflection is required to at once see that these upper cylinders will naturally become steadily more and more buoyant, and providing they are built of the proper size for the work in hand, they will exert a tremendous lifting power of thousands of tons. After these cylinders have gone up a suitable distance the lines are caught by the stationary vertical member and the ship is thus held while the floating cylinders re-fill and take a new bite; the same operation is then repeated to the surface.

Mr. Linquist intends building these cylinders, not of steel but of narrow strips of wood several inches thick, or steel may be used in certain cases. The wood strips are tongued and grooved and caulked and are held in shape by steel bands. The pressure of the water on the outside of the cylinders will in consequence tend to always tighten them, as becomes evident.

The inventor has broached and demonstrated by means of models, his unique idea to a large number of sea-going men, including commanders of salvage squadrons, and also to a number of naval men, and has received unqualified recommendations from these men, who should be qualified to judge as to the efficiency or inefficiency of such a device if anyone could. Not only is this idea of considerable promise and utilification in salvaging sunken vessels in times of peace, but it possesses according to Mr. Linquist, several valuable naval features. For one thing he has suggested that one of these hydrostatic units would prove very efficacious in the rôle of a "Submarine Base," the outfit being anchored several hundred miles from shore stations if desirable. Also they would serve as a resting place for the crew.

The inner cylinder would have a large capacity for the storage of oil and gasoline for submarines, and in the event of being sighted by a hostile war vessel, the upper cylinder and super-structure could be submerged so as to be invisible, and the inventor claims that no force, even the ocean itself, cannot budge his suction foot member an inch, once it has got its grip on the bed of the ocean by natural "sand-suction," and besides most of the floating member lies in calm water, the action of the waves not reaching very deep. A means is provided for releasing this all-powerful grip upon the ocean-bed when it becomes desirable to move the unit to some other location. U. S. Naval Officers have been favorably imprest with this idea.

In closing, it is interesting to note that another valuable possibility of this device is that of releasing stranded vessels which

(*Continued on page* 144)

AMONG the hundreds of new devices and appliances publisht monthly in The Electrical Experimenter, there are several, as a rule, which interest you. Full information on these subjects, as well as the name of the manufacturer, will be gladly furnisht to you, free of charge, by addressing our Technical Information Bureau.

ELECTRICITY NOW ROCKS THE CRADLE.

"The hand that rocks the cradle, rules the world"—runs an age old proverb, and, albeit, one that embodies more truth than fiction nowadays, perhaps, when we have the suffrage party to conjure with. But the "suffs" will have to look to their laurels, for here is an electric motor that rocks the cradle. Yes, and it doesn't object to twins or triplets. "Come one, come all," is its motto.

A Chicago Genius Has Evolved a Clever Combination—a Baby Carriage Plus an Electric Motor and Part of a Small Grinder Reduction Gear. Result—No More Pushing the Baby Carriage Back and Forth. We'll Bet His Wife Is a Suffragette!

This device not only will rock the cradle but will trundle a baby carriage back and forth on a little track, with a gentle, soothing motion which may be better than the traditional cradle rocking movements. The device was made for private use by Mr. Nels Joleen, of Chicago.

Mr. Joleen's little girl required so much of Mrs. Joleen's time that the resourceful father decided that as long as the gentle pushing to and fro of the baby carriage seemed to be a sovereign pacifier on all occasions, he would provide something which would perform the mechanical work, leaving the mother free to go about her other duties.

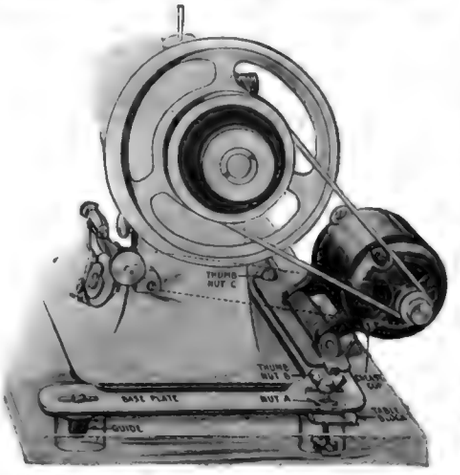
Accordingly, Mr. Joleen made the little wooden frame, shown under the wheels of the carriage; attached thereto a grinding wheel designed to be operated by hand, something which he had in the house for sharpening tools; and then attached a small motor of the kind which was once used as a sewing machine motor, accomplishing the connection by means of a belt from a very small pulley on the axle to the perifery of the grinding wheel. The driving pulley had to be made so small that he simply cut a short section of a broom handle, bored a hole thru the center, and fastened it on with a small set-screw. The gearing in the grinding wheel mechanism, originally intended to speed up the grinding wheel with reference to the number of revolutions performed by the handle, now works just the other way to all intents and purposes, as the speed of the motor must be reduced to the slow circular movement desired.

In order to transmit this motion and at the same time translate it into a back and forth movement Mr. Joleen then took a small piece of wood about three feet long, notched it at one end where it rests over a brace underneath the body of the carriage, and sawed a slot into it for a distance of a foot at the other end, this slot passing thru a hole bored in it of the size of the wood handle on the grinding mechanism, which is inserted thru the hole and then the two parts of the connecting rod brought together upon it by means of a little bolt.

Only a minute is required to trundle the little wooden frame to any place in the house, one end being provided with little casters, also shown in the picture. The motor can be attached to any lamp socket by means of a flexible attachment cord, and in this circuit near one of the binding posts on the motor Mr. Joleen has inserted a small push-button switch for starting and stopping the motor. When the carriage is set on its little track the connecting rod can be instantaneously connected by simply laying it on the bar so that the slot engages the latter, and the apparatus is ready to work. Who will be so kind as to invent an electric bottle feeder? Next!

SEWING MACHINE PLUS MOTOR, SAVES LABOR.

The sewing machine was one of the first household appliances to be equipt with an electric motor. The first motors employed were just the ordinary type, but later designs have resulted in the development of a motor having necessary speed control for use solely on sewing machines, and the efficiency and operating features of such motors have been greatly improved.



This Electric Sewing Machine Motor Drops Out of Sight with the Head and Drives Very Efficiently Owing to Its Spring Base Mounting.

The latest and most desirable features are to be found in the special motor shown in the accompanying illustration.

This type can be readily attached to any make of stationary or drop-head sewing machine, new or old, with the exception of a few obsolete models. When not in use the motor, if mounted on a stationary head machine, can be pushed back out of the way and the cover put on, or dropt with the head if used on modern types of drop-head machines. When desired, however, the motor can be removed readily by loosening one thumb screw, as it is light and portable.

The speed regulator is slipt on the treadle and held by a spring, making the mounting exceedingly simple. The operating chain is attached to the metal framework directly above the controller and pulled taut.

The regulator is light and substantial. The case is made of prest steel and the principle of operation is entirely new. When there is no pressure on the treadle the circuit is open. With a slight pressure on the treadle a contact is made and as a greater pressure is applied the resistance is cut out turn by turn. By varying the pressure, one stitch, or several hundred stitches a minute can be taken. There are approximately 100 steps in the controller, giving a corresponding number of speeds.

When folding up the machine it is only necessary to loosen the belt, disconnect the plug, and swing the motor around under the head. Felt pads underneath the base prevent the motor from scratching the finish of the machine.

The motor itself is out of the way when operating. This leaves both sides of the machine table clear so that the operator can use this space for sewing material.

The outfit, which is compact and light, consists of a small motor which operates on either alternating or direct current, mounted on a nickel-plated base, a speed regulator with operating chain and ten feet of cord and plug, and a round leather belt. The weight, including the speed regulator, is only 7 pounds.

The cost of operating this motor is so small as to be almost negligible. At 10 cents per kilowatt hour, it costs less than one cent an hour or less than it takes to run the ordinary incandescent lamp.

THE ELECTRIC TEA KETTLE IS HERE.

The recognized convenience and growing popularity of heating small quantities of water by electricity has prompted the development of the electric tea kettle illustrated.

The successful operation of an electric tea kettle depends largely upon the type of heating element—method of application of heat, etc. The heating element here used is of the submerged type, located on the bottom of the tea kettle and when in use is entirely surrounded by water. Thus all heat generated is efficiently utilized.

The tea kettle has a capacity of 2½ pints, is made of drawn copper, spun into shape; spout of white metal; has bail handle, sides of which are steel, grip made of ebonized wood comfortably shaped for convenient pouring. The lid has no hinge to come off—locks on securely. The knob forms an integral part of the metal lid.

Here We Have the Electric Tea Kettle. Hot Water When You Want It and Where You Want It Is Now an Actual Fact.

THE PROPERTIES AND COMMERCIAL APPLICATIONS OF SELENIUM.

By W. F. Alder.

Selenium was discovered by the Swedish scientist, Berzelius, in 1817 as a by-product of the distillation of sulfuric acid from iron pyrites. It has an atomic weight of 79.5 specific gravity in its electrical conducting form of 4,788, its vapor sp. gr., at 2,588°F., being 5.68.

Selenium, like sulfur, with which it is isomorphous, exists in different allotropic forms, three of which are as follows:

(1) Amorphous Selenium is formed as a finely divided brick-red powder, when a solution of selenous acid is precipitated by sulfur dioxid gas, or when the acid is reduced by suitable agents. Amorphous selenium has a sp. gr. of 4.26 and is soluble in carbon disulfide.

(2) (a) Semi-colloidal red amorphous Selenium is formed when solutions of dextrose and selenous or selenic acid are gently heated together. At 100°C. it is partially transformed into ordinary black Selenium.

(b) Colloidal Selenium can be obtained in a blood-red solution by an aqueous solution of the red precipitate obtained by the reduction of $Se\ 0_2$.

(3) Vitreous Selenium is formed when the amorphous variety is heated to 218° C. and then suddenly cooled when it forms a brittle, black, glassy mass, soluble in carbon disulfide having a sp. gr. of 4.28.

All three of the above forms have so high an electrical resistance that they may be regarded as non-conductors.

The Selenium as used in the electrical arts belongs to still another modification, viz., the crystalline or metallics state; metallic selenium is obtained when the melted vitreous variety is cooled to 210° C., and then maintained at that temperature for some time.

The gray crystalline modification which makes possible the selenium cell occurs in two forms, viz

Selenium Cell in Vacuum.

(1) Round granular crystals, stable at 140°C., an insulator in the dark and not very sensitive to changes in light intensity.

(2) Which is readily formed when the above granular form is heated to 200°C. In this form it is a relatively good conductor. It will, however, instantly respond to succeeding exposures. The general belief, also erroneous, seems to be that the shortest wave lengths, *i.e.*, the violet, are the ones which have the most pronounced effect upon the conductivity of Selenium, but exhaustive research has proven that the waves having the greatest activity for increasing the conductivity have a length of over 5,000 units.

The writer encountered innumerable difficulties which were, however, overcome in the type of cell illustrated herewith.

Electro-Deposited Mirrors Now Used for Photographic Work

IN splitting the light from a certain source, the problem of dividing the rays in definite portions may strike one at first thought as an exceedingly difficult task. In certain kinds of photographic and optical work, however, it is very essential to divide the rays in such a manner that one portion of the light will go in one direction and the remaining portion in one or more other directions. Partly transparent mirrors are used for the purpose, and in order that the precise division of light may be known beforehand, the thickness of the thin layer of metal which is deposited on a plate of glass to form the mirror must be exactly known.

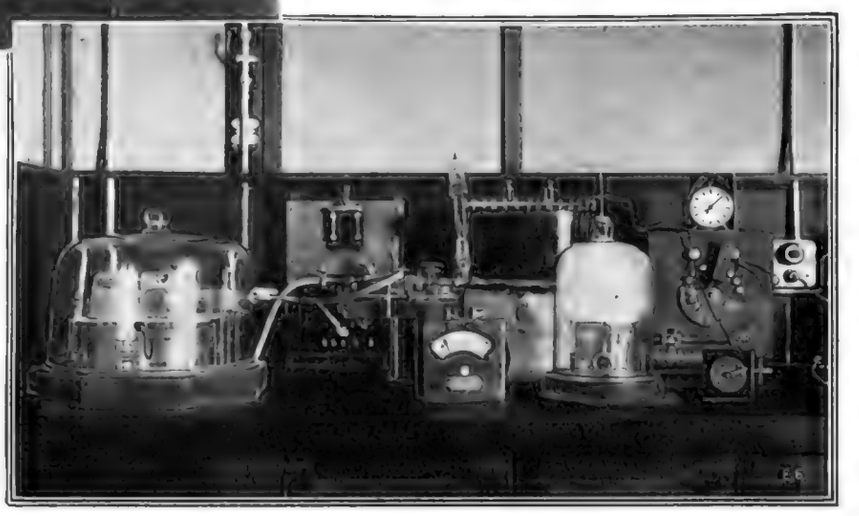


Fig. 3 (At Left). Jar for Making 11-Inch Partly Transparent Mirrors. The Cathode is at the Bottom and Consists of a Thin Sheet of Gold or Platinum-Iridium Alloy. The Glass Plate to be Coated is in a Plane Parallel to the Cathode.

Fig. 1 (Below). Arrangement of Apparatus for Electroplating Partly Transparent Mirrors in a Vacuum, the Smaller Jar Being in Operation.

In Fig. 1 is shown the apparatus developed in the research laboratory of one of the leading camera manufacturers for use in making mirrors of different degrees of transparencies employed in certain important photographic experiments. Two inverted glass bell jars are shown, each of which is connected to a vacuum-pump system. By means of this arrangement the air pressure inside the jars is reduced to a scant millimeter. This is done because in a rarefied gas the passage of electricity from the cathode, the terminal at the bottom of each jar, to the anode—the upper terminal, is greatly facilitated. The cathode consists of a very thin sheet of metal, which usually is of gold or an alloy of platinum and iridium. A short distance above this sheet of metal in a plane parallel to it; the glass plate to be coated is placed on glass pillars as shown.

The larger jar is 16 inches in diameter and 11 inches high and is used for coating mirrors 11 inches square. With the air exhausted the atmospheric pressure on this jar (about 15 pounds per square inch) mounts up to approximately five tons. The current is measured in thousandths of an ampere (milliamperes). The voltage, however, is very high and is stept up by a transformer from a value of 156 volts to 5,000 volts.

As soon as the current is turned on a pink glow is noticeable in the jar. Just above the thin metal cathode, however, there is a certain dark region which is called the Crooke's dark space. The action of the current causes minute particles of metal to leave the cathode and to be deposited on the glass plate which is placed just at the edge of the Crooke's dark space, where the metal is most cohesively deposited. With the current constant it is only necessary to record the time of operation; the amount of metal deposited can then be easily determined, since it will, according to Faraday's law, be proportional to the time and current.

In Fig. 2 is shown a set of interesting curves obtained in a typical run with a

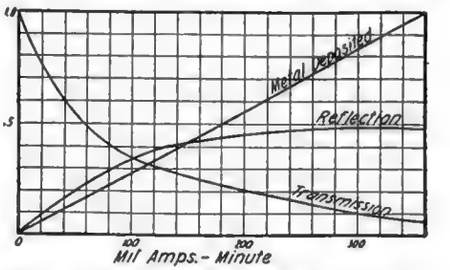


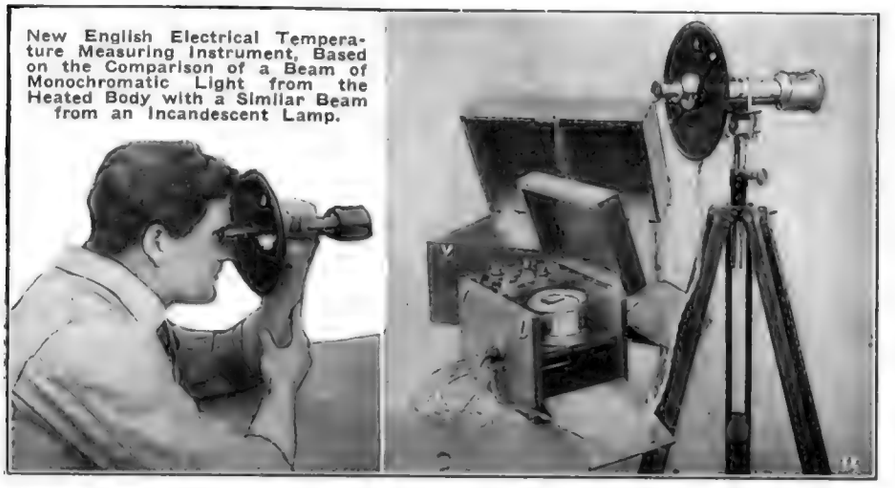
Fig. 2. Curves Showing Reflecting Power at 45 Degrees Incidence and Percentage of Metal Deposited and Light Transmitted for Platinum-Iridium Mirror With Varying Products of Time and Current.

cathode of 70 per cent platinum and 30 per cent iridium, measuring 120 millimeters by 120 millimeters by 0.1 millimeter. These curves show the reflecting power at 45 degrees incidence and the percentage of light transmitted and metal deposited on a unit of area for varying products of current and time. It was found that a mirror whose transmission was equal to its reflection required a deposit of 3.4 milligrams per square decimeter.

Photos courtesy of Eastman Kodak Co.

A New Optical Pyrometer

The new pyrometer here shown is a practical, convenient, and at the same time, accurate instrument, which can be successfully used by unskilled workmen. Temperatures from 700°C. upwards are read directly upon clear, open scales. Owing to the rapidity with which readings can be taken, and the ease of sighting upon small objects, this pyrometer is particularly suitable for research purposes and in many processes in steel, pottery, glass and other works. It has been developed by an English concern.



New English Electrical Temperature Measuring Instrument, Based on the Comparison of a Beam of Monochromatic Light from the Heated Body with a Similar Beam from an Incandescent Lamp.

The instrument may be regarded as a photometer, in which, by simply rotating the eyepiece, a beam of selected monochromatic light from the hot body is adjusted to equal intensity with a beam of similar light from an incandescent electric lamp. It is not a color-matching instrument, and in consequence of the simple construction, accurate readings can be taken repeatedly by different observers with remarkable consistency. The formula, which expresses the relationship between the intensity of the radiation of a hot body and its temperature, has been examined both theoretically and practically by many investigators and has been shown to give results of great accuracy up to the highest temperatures. The constants of this formula for every instrument are individually determined at several temperatures before calibration.

The general arrangement of the instrument is shown in the figure and includes:—The pyrometer, consisting of the optical system, the electric lamp, the shield carrying the temperature scale and pointer; the teak carrying-case with fittings for fixing the pyrometer and standard lamp for checking; 4-volt accumulator, ammeter and regulating resistance, complete in teak case; the standard lamp and an adjustable tripod stand.

The following is a brief explanation of the construction. Behind the enlarged part in the front of the pyrometer in which is fitted the electric lamp, are two holes. Light from the object (such as a furnace) under observation passes thru one, and light from the lamp thru the other. These beams of light then pass thru a system of lenses and prisms, are polarised in different planes and rendered monochromatic. Finally the two beams of light pass thru a single ocular. The observer sees an illuminated circular field divided into two semi-circles One semi-circle is filled by an image of the hot body under observation, while the other is uniformly illuminated by the electric lamp. The two semi-circles are brought to an equal intensity of illumination by turning the eyepiece to which the scale pointer is directly attached as seen.

In this manner the unknown rays are compared with those of known intensity from the electric lamp. As the accuracy depends upon the constancy of the light from the electric lamp, a small ammeter and regulating resistance are fitted in the box containing the accumulator to ensure that whatever the voltage of the battery may be, the current passing thru the lamp is constant. To ensure that the candlepower of the lamp shall remain constant over long periods as the filament ages, provision is made for calibrating the instrument from time to time against a standard amyl-acetate lamp, and thus ascertaining the correct reading of the ammeter when the electric lamp is giving the correct illumination. This test need only be made at long intervals and the standard lamp need not be carried into the factory or plant.

The pyrometer is supplied fitted with one or more temperature scales of any desired range from 700°C. upwards, but the following standard ranges are suggested as suitable for most practical considerations: single scale instruments, 700-1400°C.; single scale instruments, 900-2000°C.; double scale instruments, 700-1400°C. and 1200-2500°C.; double scale instruments, 900-2000°C. and 1400-4000°C.

ELECTRIC COUCH INDUCES CURRENTS IN THE BODY.

By H. H. Parker

The electric couch described in this article makes possible a simple application of the commercial alternating current in the electro-therapeutical treatment of insomnia, hardening of the arteries, nervous disorders and other similar ailments; a number of sufferers from such troubles claim that they have been greatly benefited thru its use. While the apparatus has been constructed in various forms, the one described has the advantages of simplicity, lightness, neat appearance and ease of operation, provision being made for connection to any lighting circuit carrying alternating current at 110 or 220 volts and any frequency.

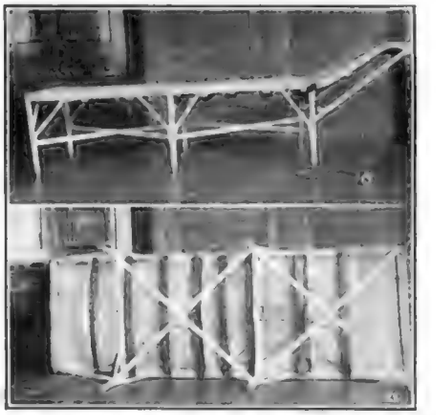
The couch itself is an ordinary wickerwork affair, to the bottom of which are fastened a series of coils, wound upon laminated sheet iron cores. In the one shown in the illustration eight coils are used, connected in series for 220 volts and in series-parallel in groups of four in series when operating on 110 volts. At a convenient point at the head of the couch is placed a wall key socket for cord and plug.

Owing to the use of alternating current, laminated iron cores must be provided for the coils; these are built up of No. 22 gage iron strips one and a half inches wide by twenty-six inches long, the completed core being about half an inch thick. The strips are shellacked before being put together, and are held by paper insulated rivets in order to prevent the formation of eddy currents in the iron or rivets. After insulating the cores they are wound with two layers each of No. 20 D.C.C. magnet wire, coated with shellac or insulating varnish, wrapt with cotton armature binding tape and then bent to conform somewhat to the curve of the couch surface when sagged by the weight of a patient lying upon it.

As part of the equipment a *Test Coil* is provided. This comprises a built-up iron core similar to the others, but only about three-quarters of an inch square in section. At its center is wound two layers of No. 25 D.C.C. magnet wire in a coil about six inches long, the terminals of which are carried to a miniature lamp socket at the end of the core containing a two-and-a-half volt battery lamp. This wand-like contrivance is considered by the patient an indispensable part of the outfit, and is used to determine when the couch is "working." When brought into the influence of the rapidly alternating, magnetic field surrounding the coils the little lamp is lighted, the dimensions of its coil being such that the core may be laid upon the couch in close proximity to the coils beneath without danger of burning out the bulb. By moving the *test coil* away from and around the couch a visible demonstration of the strength and extent of the magnetic field is afforded.

To operate the couch the patient merely lies down upon it and switches on the current. No physical effect is noticeable beyond a slight vibration due to the alternating current, the beneficial results obtained being supposedly an effect of the rapidly alternating magnetic field surrounding the body.

There appears to be a difference of opinion among medical men as to the exact action of this magnetic field upon the human system, but in looking at the subject from the engineer's instead of the physician's viewpoint, the following theory suggests itself: Do the blood circulatory passages, the veins and arteries, or any of the organs or other parts, form, as it were, the closed *secondary circuit* of a transformer, in which currents are induced through the action of the magnetic field produced by the alternating current flowing in the *primary* winding of the coils beneath the couch?



Unique Electric Couch Which Passes Powerful, Alternating Magnetic Fields Thru the Body.

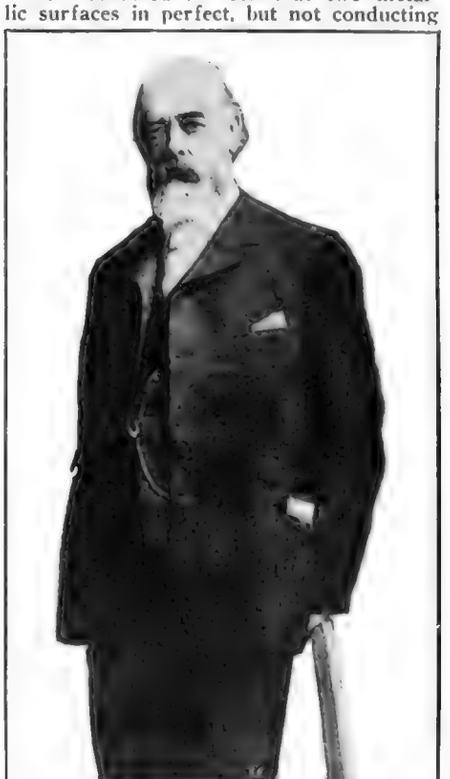
SIR OLIVER JOSEPH LODGE.
June, 1917, Marks His 66th Birth Anniversary.

One of the most profound scientific workers and thinkers we have ever had, is Sir Oliver Joseph Lodge, who is still an active figure in the field of scientific research, and all of us expect in the near future to see something even more wonderful than any of his preceding discoveries and inventions.

Sir Oliver Joseph Lodge was born on June 12, 1851, at Penkull, Staffordshire, England. He received his early education in the Newport Grammar School and later he entered the University of Coll, London, where he specialized in scientific and mathematical research. His scientific trend was noticed by the professors of different universities, and after he had graduated from this institution he was elected as Professor of Physics at the University of Liverpool. Since 1900 he has been principal of the University of Birmingham.

He has had many honors and degrees conferred upon him and is an active member of many of the leading scientific institutions. Sir Oliver Lodge was presented with the honorary degree of Doctor of Science from Oxford, Cambridge, Victoria, Liverpool and others, also that of LL.D. from St. Andrews, Glasgow and Aberlaide. He was president of the Mathematical and Physical section of the British Association in 1891 and President of the Physical Society of London. His most important work in electro-physical science is that of *wireless telegraphy*, in which he has introduced some of the most fundamental steps in commercializing this fascinating art, and in fact he is called by many the father of wireless. The Lodge coherer was the first instrument used for successfully receiving radio waves.

He discovered in 1889 that two metallic surfaces in perfect, but not conducting contact, were welded together when an electric discharge past between them, and later on studied the propagation of electric waves along wires. He thus came into close contact with the researches of Hertz on the creation of electromagnetic waves in free space, and this work he both expounded and extended.



Sir Oliver Joseph Lodge, Famous English Physicist and Savant. He Is Regarded by Many as the Dean of Present-Day Scientists.

His interest in these matters was, however, scientific rather than technical, and he himself has admitted that before the matter had received attention from others it had not occurred to him to suggest the employment of Hertzian waves for practical telegraphic purposes. In the course of his scientific work he had directed much attention to the phenomena of electrical resonance. Hence, when it had been indicated that the chief practical importance of Hertzian waves might be in their application to space-telegraphy, Lodge was not slow to apply his knowledge to this subject.

On May 10, 1897, Lodge applied for a provision patent protection in Great Britain for improvements in Syntonizing Telegraphy Without Line Wires, and in this document he states that the subject of his invention was to enable an operator to transmit messages across space to *any one or more of a number of different individuals* in various localities, each of whom is provided with a suitably arranged and "tuned" receiver. The subject-matter of the specification deals exclusively with the utilization of electromagnetic waves. This is the noted Lodge tuning patent which is universally employed in all forms of radio transmitting apparatus today. The patent recently expired and became public property.

Sir Oliver Lodge is a noted author, and some of his most important works are "Elementary Mechanics," "Modern Views of Electricity," "Pioneers of Science," "Signalling Thru Space Without Wires," "Life and Matter," "Lightning Conductors and Lightning Guards," "Modern Views of Matter," "Man and the Universe," and his latest book, "Raymond—A Treatise of Life and Death," which purports to prove that the author actually received communications from his dead son, who was killed while serving with the English army in France. His theory however was received coldly by the scientific world.

Prof. Bell Receives "Civic Forum Medal" For 1917

The accompanying photo shows the presentation of the "Civic Forum Medal" for 1917, to Dr. Alexander Graham Bell, the inventor of the telephone. Those in the picture from left to right are: John J. Carty, chief engineer of the American Telephone and Telegraph Company; Union N. Bethell, president of the New York Telephone Company and senior vice-president of the American Telephone and Telegraph Company; Dr. John H. Finley, (presenter of the medal); Alexander Graham Bell, inventor of the telephone, and Thomas A. Watson, associate of Dr. Bell, maker of the first telephone instrument and receiver of the first telephone message. On the table are the first instruments used by Dr. Bell.

On March 21, in Carnegie Hall, New York, Dr. Alexander Graham Bell, was formally presented with the Civic Forum Medal of honor for distinguished public service, in recognition of his invention of the telephone in 1876.

The medal was established in 1914 to express the sentiment of the American people toward their great living men and women. Its purpose is to promote more general appreciation of distinguished public service and inspire ambition to emulate such service.

The medal this year was awarded to Dr. Bell by vote of the members of the National Council of Seventy, representing the whole country, geographically and so far as possible in all other respects.

The medal was first presented to Maj. Gen. George Washington Goethals, U. S. A., in 1914 for his work in building the Panama Canal. In 1915 it was presented to Thomas A. Edison in recognition of his contributions to electrical inventions.

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The Inspiring Moment When Professor Bell, Inventor of the Telephone, Was Presented With the "Civic Forum Medal" at New York, on March 21st. Reading Left to Right—John J. Carty, Union N. Bethell, Dr. John H. Finley, Prof. Bell and Thomas A. Watson, Who Made the First Telephone for Prof. Bell.

HOW ELECTRIC VEHICLES BOOST EFFICIENCY.

A New York department store speeds up the loading of its delivery wagons by running its "electrics" inside of the building and transporting them to various floors on large elevators.

Joe's Experiment

By C. M. Adams

"AND another thing," Mr. Robertson checked Pete; "don't bring that blind kid around here any more. He's just in the way, and if he gets hurt the company'll have the damages to pay. What business has a blind kid got around an electric plant, anyhow? You keep him out of here, understand?"

Pete Foley whirled and surveyed the nervous, drawn face of his chief for a moment, and then flung back hotly:

"Look here, that boy's a friend of mine and a mighty good friend. He's not in your way when he comes around here, and I'm responsible for his safety. As for what business he's got around an electric plant, let me tell you that he knows more about electricity right now than some men who are paid big money for what they are supposed to know. He'll make his mark some of these days when he gets into the electrical world, you'll see. And furthermore, he's going to come here whenever he wants to, as long as I'm around."

Mr. Robertson's white, haggard face flushed angrily and his lips parted as if to speak. But he was silent as Pete swung out of the power house and up the trail to the company's tool shack. Pete Foley was a good electrician, a very good electrician, and men with this particular kind of goodness were so scarce in these mountains that it behooved Mr. Robertson to stand for much from this member of his construction crew.

Half way up the road to his home on the mountain-side, Joe Benson paused and listened to the faint purr of unit No. 1, far away down the slope. Ever since the Snake River Power Company had started the first day's work on this water power project, Joe had been an interested listener of everything that went on. Listening had been his chief avenue of impression, for his eyes were useless, and had been so for several years. He had heard the rumble of the blasts, and the grit and grind of drills and steam shovels as they prepared for the big concrete dam which held back the water. He had listened and been interested, but mystified, until Pete Foley, a member of the electrical construction crew, had come to board at his home.

It was Pete who had answered his *hows* and *whys* about the plant and its operation, and during the year which had elapsed Joe absorbed electrical information like a dry sponge taking in water.

At first he had listened to the conversation of the men, but had been loath to take part in it because he felt his own ignorance of their work. However, as time past, and Pete's daily instructions bore fruit, he began to take a more active part in the talk of the men during the evening.

At first they had regarded him as an outsider, whose ignorance of their work was to be tolerated for politeness sake only. But gradually, as Joe's comments and questions became more intelligent, they began to look to him as an equal—as one of their own number professionally.

"I'll be hanged if that kid don't know as much about the plant as I do," one of them ejaculated admiringly, after Joe had come off victorious in a technical argument.

"Sure he does," Pete retorted. "Don't think he don't know anything because he can't see. He'll make his mark—you watch."

At first the size of the Snake River project had dazzled Joe. Then with a realization of the extent of the undertaking had come, at first as a dream, and then a resolve, the idea that he, too, would become an electrical man, an electrical engineer. True, he was blind. But he was attending the high school up the valley and in two years would be ready to enter the university. Other blind men had done things equally as wonderful. Why could he not enter this field?

And what a day this had been, what a wealth of impression and sensation. He had stood beside the great towering masses of iron and copper and had felt with his own sensitive hands the giant castings and coils of the great generators, while Pete explained how they were built and worked. So this April afternoon he went home warmly glowing with new impressions and desires.

Pete did not have time to talk after supper. He went upstairs for his clothes and then disappeared down the slope in the company car, on his way to Merwin to complete preparations for the transformers in the sub-station there. And so Joe sat on the porch and listened to the faint hum of the generators below him,

"No, you don't. Not me," Pete interrupted, as Mr. Robertson turned to him. "Here's the boy you want to thank. He saved your plant and not me."

LAST month we publisht a rattling good story—"Eddy Currents"—by Mr. Adams. We confidently believe that the present tale will appeal to all dyed-in-the-wool electrical readers. You don't require an electrical education to become "en rapport" with the author, as he possesses that happy faculty of weaving the technical and personal aspects in such a way that the moral cannot be mist. The facts related in this story are human, pertinent every-day affairs. Similar obstacles to those facing invincible Joe Benson, the hero of this narrative, have confronted all of us at one time or another. But true "Philosophy" will unlock all doors and surmount the greatest of barriers.

while he dreamed of his future.

Two days later when Pete returned from Merwin, Joe was waiting for him after supper as the group of boarders gathered on the porch.

"Pete," Joe began, "I've been wanting to ask you something since day before yesterday, but you weren't here to answer it."

"Go ahead, but don't go too deep. Remember I'm only an ordinary electrician," Pete warned.

"Well," Joe went on, "on one of those switchboard panels you showed me the other day there was a rheostat, but you didn't say what it was for. What does it do, anyhow?"

"Oh, that's the rheostat for the exciter's field," Pete responded. "It's connected in the shunt winding of the exciter field coils. It controls the voltage."

"What does it do that for?" Joe insisted, going to the bottom of the matter.

"Well, here's the idea," Pete explained. "You see the exciter supplies current to the field of the big alternator. Well, the voltage of the alternator will depend on the voltage of the exciter, because if the voltage of the exciter changes the strength of the field will change and affect the alternator's voltage. So if they want to raise or lower the voltage of the big alternator, they just raise or lower the exciter voltage by putting in more or less resistance with this rheostat. Do you understand?"

"Oh, yes," Joe replied. "Then by adjusting this field rheostat on the exciter you can change the voltage of the big alternator."

"Exactly," Pete assented.

Joe sat for some moments, thinking of this new addition to his store of electrical information, while the men about him talked lazily.

"Robertson's getting grouchy about those transformers, I tell you," one of the men said a moment later.

"If they don't come, the company won't be able to get its franchise, and he seems to think it's up to him to get them here."

"I know that all right, but he oughtn't to treat the rest of us like we were to blame," Pete retorted. "He's been a fright for the last two weeks."

"What transformers are those?" Joe asked.

"The transformers for the Merwin substation, the step-down set," Pete informed him.

"Haven't they come yet?" Joe asked in surprise.

"No, they've been shipt a week but can't be located on the road or anywhere else."

"What will he do if they don't come?" Joe asked in concern.

"I don't know. That's what's bothering him, I guess," Pete replied.

The generators at Portage Falls developed current at low voltage which was then past thru a set of transformers which stept it up to sixteen thousand, five hundred volts, at which tension it was transmitted to Merwin, fifteen miles away over the mountains. There it was stept down to two thousand, three hundred volts for distribution thru the service lines of the city. Joe knew this as well as the rest of the men. He also knew now that if the step-down transformers did not arrive, the Snake River Power Company would be in a very awkward position.

Its franchise required it to supply current to Merwin on May first. Today was April twenty-seventh.

Joe knew that the sixteen thousand volt current could not be turned directly into the city lines. He knew that burned out equipment and electrocuted people would be the result. The voltage had to be lowered, but how? He wondered about it and tried to think what Mr. Robertson would do, as he sat on the porch and listened to the men talking, and far away the faint hum of the generators in the power house, limbering up their bearings.

Of what use would this power be if there were no transformers at Merwin? Without the intervening coils the big machines would be as useless as if their windings were stript from them. He thought of this and tried to answer for himself the question that was puzzling the chief of construction.

"What do you suppose Mr. Robertson will do?" he asked Pete as the latter started upstairs for bed.

IN THAT "JULY" E. E.

Are There Currents About a Magnet?—with a number of original photos and charts never publisht before. —by F. F. Mace.

"Cold Light" or La Lumière Froide, as the French call it. The work of Prof. Dussaud.

Back to the Days of "Volta"—with some extremely interesting photos of Volta's original apparatus—by Jacques Boyer, our Paris Correspondent.

"Ham Jones—Scientist"—a rollicking good electrical story with a live-wire wallop in every line by H. W. Eycleth.

The Marvels of Radioactivity by Jerome S. Marcus.

Lightning—How to Protect Yourself from It—An article everyone should read by W. G. Whitman. With illustrations.

Where the Radio Amateur Fits in the U. S. Naval Reserve Force by M. B. West.

A Page of Marvelous X-Ray Skiagraphs, including one of a four-legged chicken.

The Calculation and Measurement of Inductance—Conclusion by H. Winfield Secor and Samuel Cohen.

Besides these and a large number of other valuable and interesting articles, there will appear a liberal sprinkling of timely summer-time topics of interest to all readers. Don't miss the "July Issue!" It'll be right there waiting for you with a wallop on every page.

"Go crazy, if those transformers don't come," Pete replied unconcernedly.

The next day Joe found himself thinking of the problem again as he heard the machines purring away on his way home from school. That night as he sat on the porch he was still thinking of it, and yet had found no ready solution for the difficulty.

"I don't see how they're going to fix that up if those transformers don't come," he complained to Pete.

"Great guns, you aren't trying to figure out a way, are you?" Pete exclaimed.

"Why yes, I ought to be able to, or try anyhow," Joe protested.

"Let Robertson do that. He's paid for worrying," Pete returned easily.

But that did not satisfy Joe. The plant below him had grown under his very doorstep. He had heard every bit of metal and concrete put into place, and he felt as if the thing were his own. Then, too, was he not going to be a consulting engineer some day; would not a problem similar to this be put to him for solution? He ought at least to attempt to solve it now. So he puzzled his brain over the thing that night and all the next day, suggesting, rejecting, scheming and pondering. But by the evening of the twenty-ninth he had not reached any solution.

He was not the only one who was thinking of this problem. The worried, anxious face of Mr. Robertson, with its black-ringed eyes, glittering with sleeplessness, testified too plainly of his own struggle over the proposition.

He remained at Portage Falls directing bits of finishing work, while he hoped and almost prayed for the momentary arrival of the coils so much needed. Hourly he telephoned to Merwin to see if they had arrived. Hourly he hoped that they might have come, and then grew despairing as he was told they had not.

On the morning of the thirtieth he went to Merwin with the determination of staying there until they came, and hoping against hope that service could be started on time.

Pete and the others stayed behind at Portage Falls, finishing up fine points of the work there. The plant was in order, each great machine ready to send its thousands of kilowatts over the line to Merwin to be used for every sort of work, provided the intervening transformers were there to step down the deadly high tension to a safe voltage. But at noon a message to the Falls reported that no transformers had arrived.

Pete loafed up the steps of the Benson home at dinner time. Worry over what would happen to the company did not interfere with his appetite, and he was ready for the food awaiting him.

But five minutes after he had sauntered leisurely inside, he dashed out, leaped off the porch, and raced down the steep hillside, recklessly speeding toward the company's tool shack at the bottom. A minute later he flung open the doors of the building and was cranking the little service automobile. Two minutes later and the pebbles were flying in a stream from his tires as he bumped away over the rough roads toward Merwin

An hour and a half later he stopt Mr. Robertson's big high-power roadster before the building, while the chief himself sprang out and dashed down to the power house, with Pete closely pursuing him.

* * * * * *

It was a varied group which clustered about the switchboard, handsomely drest directors, oilers and workmen in overalls,

(*Continued on page* 150)

AN ELECTRIC SEMAPHORE FOR AUTOISTS.

The accompanying photograph shows a cleverly designed automobile electric signal device which has recently been developed by the well-known civil engineer, Mr. H. Hartman, of New York City.

Motorists Will Be Interested In the Electric Semaphore Signal Here Illustrated. It Is Operated By Electro-Magnets, Controlled By a Push Button On the Steering Wheel. The Arm Hangs Downward Normally, and Carries a Red Signal Lamp At Its Extremity. The Bull's-eye At the Hub Is Also Illuminated.

This, like other inventions of Mr. Hartman, is really quite simple in construction and performs its functional duty just as well, or perhaps better, than many existing and more complicated similar devices. The sole purpose of this instrument is to warn an automobilist in which direction the machine ahead of him is going to turn, either to right or left.

It consists of a magnetic field having two magnetizing coils similar in design to the field of a motor. An armature coil is placed in this field, and its shaft is attached to the signal or semaphore arm. The field and armature are enclosed in a waterproof metal case which is seen on the left. One end of the pointer is fitted with a red lamp so as to serve as a danger signal.

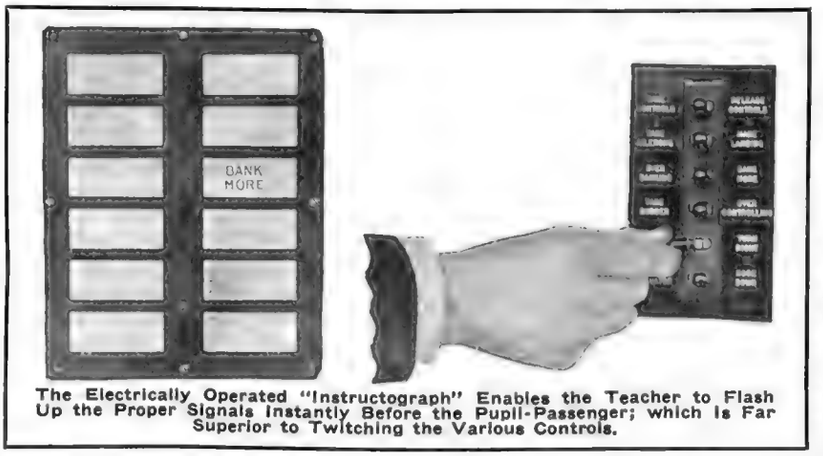
The armature and field coils are connected to a storage battery and a simple switch, so that the autoist can throw the arm either towards the left or right, whichever the case might be. The principle upon which this instrument is based is that of the repulsion and attraction of two different magnets, one stationary (the field), while the movable magnet is the armature. The arm at its normal position points downward, and as soon as the proper current is past thru the field and armature, the pivoted arm turns instantaneously to that direction, by virtue of the attraction between a field coil and the armature coil. Automobilists of to-day whose slogan is *Safety First* will appreciate this very valuable device, as it cannot be mistaken owing to the relatively large moving surface called into play.

AN ELECTRIC INSTRUCTOGRAPH FOR TEACHING AVIATORS.

One of the latest Sperry devices for aviators, or rather for would-be aviators, is known as the *Instructograph* and is illustrated herewith. It is intended to facilitate the instruction of pupils in the modern two-passenger tractor aeroplane. Prior to the advent of this clever device the Pilot-Instructor, occupying the rear seat of the machine, depended on twitching the various controls, after attracting the attention of his pupil-passenger by kicking the back of the forward seat, for imparting such instruction as was necessary. This crude method of communication is very dangerous, as at times neither pupil nor instructor know whether the control of the plane is in their hands or not, as becomes readily apparent.

The Instructograph consists of three units: the transmitting unit, the receiving unit and a battery case, and while the pieces are of light and compact construction, the complete installation weighing but six pounds, without batteries, they have been designed for the strength and durability necessary for the hard usage they will be subjected to in service.

The *Transmitter* consists of a case, of light metal construction, about six inches long, three inches thick, and an inch wide. A series of six double throw keys project from one edge, to the right and left of which extend engraved plates, bearing all of the instructions commonly used in teaching the art of flying. The keys, which are of such size that they can be easily handled with gloved hands, can be thrown to either the right or left, remaining in the position placed until released by a touch, when they fly up to their normal vertical position. The twelve instructions themselves, neatly lettered, have been chosen with great ingenuity and are so placed that actual air work cannot necessitate the use of both of the two directions, placed by each of the keys, at the same time. The case itself can either be fastened by the side of the instructor, or set into the instrument board before him, as found convenient.



The Electrically Operated "Instructograph" Enables the Teacher to Flash Up the Proper Signals Instantly Before the Pupil-Passenger; which Is Far Superior to Twitching the Various Controls.

The *Receiver* is a box approximately seven inches long, five inches wide and slightly over one inch thick, adapted to fasten on the wheel of the front control itself in the front cockpit of a tractor, under the cowl, or in the instrument board. Its cover is perforated by twelve oblong windows, closed by translucent white celluloid, with no lettering of any kind visible to confuse the pupil. When one of the keys of the *Transmitter* is thrown, the corresponding direction appears on a window in dense black against an illuminated white background. Three of the directions: "Nose Down," "Over Banking" and "Over Controlling" flash out in black against a red background, clearly indicating the urgency of the command. An ingenious arrangement of small electric light bulbs enables this method of communication to possess the advantage of positively attracting the pupil's attention whenever a word of instruction is given, it having been found experimentally that the flash of light accompanying the change of direction catches his subconscious attention. To safeguard against the possibility of a burned out bulb preventing the direction from being received, the circuits are so arranged that a second lamp remains lighted.

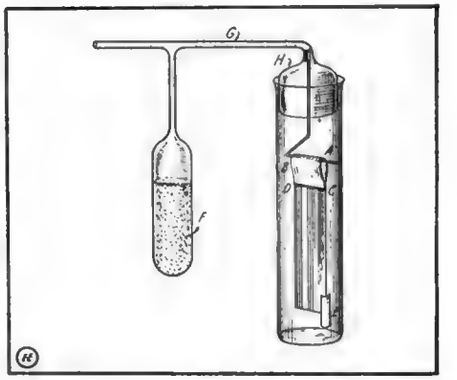
NEW METHOD OF MEASURING PRESSURE OF LIGHT.

In a paper to the Physical Society, Mr. Gilbert D. West describes the measurement of the pressure of light by a method requiring few of the elaborate precautions generally necessary in such experiments. The essential feature of the apparatus was a strip of gold leaf suspended in the middle of a test tube containing air or hydrogen at reduced pressure. Radiation from a 32 c.p. carbon filament lamp, impinging directly on one side of the strip, was sufficient to cause a microscopically measureable deflection of the end.

The pressure of normally incident radiation on a perfectly reflecting surface has been shown by Maxwell and others to be numerically equal to twice the energy content of the radiation per unit volume, and hence, if this quantity be measured in the way described below, a check on the original observations can be made. A mean of the results of several successive experiments with the deflected strips gave a value for the pressure of radiation which only differed from that calculated from the energy density by a small percentage. The accuracy and constancy of the final results seemed to preclude their being seriously affected by gas action; but, as gas action had to be taken into consideration, the present research was undertaken with a view to its fuller investigation, and if possible to complete elimination.

In measuring the energy density, the initial rate of rise of temperature of a blackened copper plate, enclosed in the tube, was measured by means of an attached copper eureka thermo-junction. Due allowance was made for cooling corrections, and the lamp black was assumed to absorb 95 per cent of the incident radiation. The cold junction was immersed in oil contained in a vacuum flask, and during an experiment a delicate indicating thermometer in the oil only showed negligible variations. The calibration of the thermo-junction was carried out in the usual way, and a number of minor matters received full consideration.

When from the measurements thus taken the energy reaching 1 sq. cm. in one second



Arrangement of Apparatus for Measuring Pressure of Light.—H Is Hollow Stopper, E Is Cover Glass Cemented to Tube, F Contains Pith Charcoal, G Is Tube Which May Be Connected to Gaide Pump.

is known, the energy per 1 c.c. can be calculated from a knowledge of the velocity of light.

(*Continued on page 142*)

NEW TELEPHONE SIGNAL A PATIENCE SAVER.

Patience vanishes rapidly while holding a telephone line. Save your time and attend to other important matters while waiting for the other party to resume conversation, say the sponsors of the new Hold-the-call-signal here illustrated. This clever

How Often Do You Feel Like Cussing the Telephone When Party No. 2 Says "Hold the Line"? The Answer Is—Don't. Place the Receiver On the Amplifier Here Shown and You Will Hear the Party Answer.

device will let you know when the speaker is ready. No electrical connection is needed. It simply rests alongside of the instrument and the receiver is placed on it while line is held open.

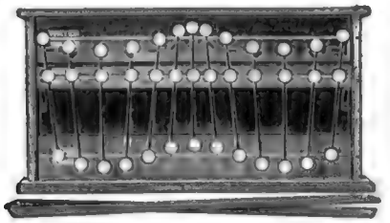
HOW STUDENTS STUDY WAVE MOTION.

When the college "Prof." tries to drum the principles of wave motion into his pupils' craniums, he has available today the mechanical wave reproduction machine here illustrated. The small white discs form into various lines representing curves or waves of certain kinds, depending on how the apparatus is operated. This remarkable model was invented by Dr. Charles Forbes of Columbia University. With this apparatus the formation and propagation of the three general classes of wave motions may be demonstrated, namely:

Water or Surface Waves, in which the elliptical motion of the particles of water, the advancing of the crest tending to form breakers, the recession of the trough tending to form the undertow are exhibited.

Sound Waves, or waves of condensation and rarefaction, in which the amplitude of vibration may be changed by lowering the disc support. The lowering of the distant end of the support will also represent the decrease in the loudness of sound.

Ether Waves, or transverse vibrations, rep-



By Means of This Oscillating Pendulum Cabinet It Becomes a Sinecure for the "Prof." to Inculcate His Pupils with the Fundamentals of Various Wave Motions.

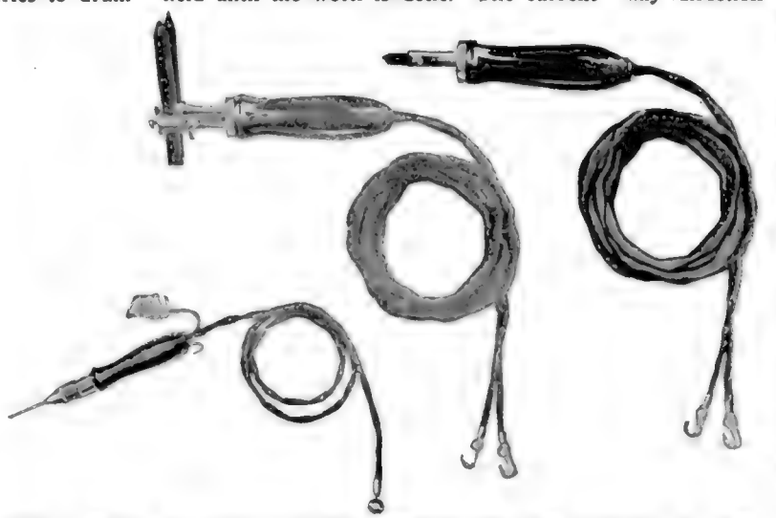
resenting the production of light, heat and electric waves. The progressive undulations of a vibrating cord are also represented. Comparison of Phases. The apparatus admits of a ready comparison of similar phases in the three systems of wave motions, a very desirable feature not possest by any other form of wave machine. By means of the covers resting upon the framework of the apparatus any one or two of the wave systems may be hidden from view, thus leaving the remainder for special examination when desired. The front of the apparatus exhibits the conversion of rotary into direct and lateral reciprocating rectilinear motions. On the back, the action of the crank handle, the rod connecting the individual cranks, and the operation of the double parallel rule mechanical motion, first used in this apparatus, are clearly exhibited. Its large size is especially advantageous, since the wave forms can be clearly seen across a large lecture room.

UNIQUE ELECTRIC SOLDERING TOOL.

A Buffalo concern has recently brought out a new form of electric soldering tool. Among these tools is a two-prong iron with prongs of solid bar brass with nickel-plated finish. This type of iron is furnished in capacities of 150 watts, 250 watts and 500 watts. All are designed to work on low pressure, from 6 to 15 volts, either direct or alternating. This pressure can be obtained from an ordinary lighting or power circuit, either 25 or 60 cycles by interposing a low-voltage transformer, or a storage battery operating at a pressure of 12 volts can be used. Under no circumstances may these irons be used on any voltage over 15.

Another type is the two-handle portable soldering outfit. This is composed of a single prong soldering tool attached to one wire of the secondary side of the transformer and a solder-feeding tool attached to the other secondary wire of the transformer. When a storage battery is used the single prong soldering tool is attached to the negative side, and the solder-feeding tool to the positive side of the latter.

When soldering with this outfit the single prong point is brought to bear upon the object to be soldered, and the solder-feeding tool is brought to bear upon the spot where soldering is needed. The instant the circuit is closed the heat point glows with a white heat, and the solder is held until the work is done. The current

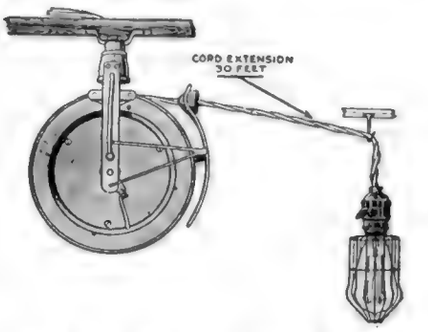


Several Styles of a Unique Electric Soldering Iron That Operates On Low Voltage A.C. or D.C. Closing the Circuit Causes the Points to Heat Up, When the Solder Is Applied.

ceases to flow as soon as the heating point is taken from the work. This outfit is made in 150- and 300-watt capacities and is designed for use on direct or alternating currents up to 12 volts pressure.

AN AUTOMATIC EXTENSION REEL FOR DROP LIGHTS.

The automatic extension reel here illustrated is intended for drop or portable electric lamps. It is simple in construction and positive in operation.



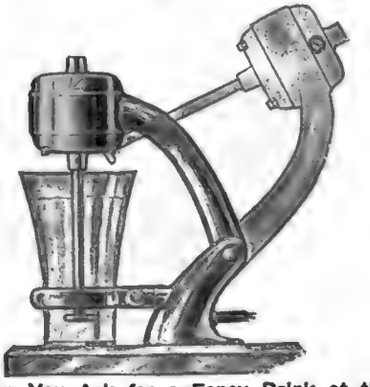
A Clever Invention In the Form of An Automatic Extension Reel for Portable Electric Lamps, Which Winds the 30-foot Cord Up and Swivels In Any Direction.

It is designed especially for garages, blacksmiths, factories, stores, or any business requiring an extension light. This reel is equipt with 30 feet of lamp cord, easily secured by fastening the arms of the swivel joint to ceiling or beam, as shown. This swivel joint enables one to walk in any direction with the lamp. It has an automatic lock ingeniously arranged to lock and hold the lamp any distance from the reel. A slight pull forward unlocks the ratchet and the reel revolves, winding the cord back as you advance toward the reel with lamp in hand.

A HANDY ELECTRIC DRINK MIXER.

The soda clerk used to cuss (inwardly) merrily whenever a patron called for a drink that required a fancy mixture—a chocolate milk shake for instance. Wherefore and hence we have in our midst the electric drink mixer that never tires—no matter if you had a thirst like an Arabian camel.

The electric drink mixer is mounted on a swinging bracket. When the machine is pushed back and removed from the glass it takes the position indicated by the dotted lines. Throwing back



When You Ask for a Fancy Drink at the Soda Fountain the Dispenser Now Places the Glass Under An Electric Drink Mixer.

the bracket operates a switch which breaks the circuit. The swinging down of the bracket automatically closes the circuit.

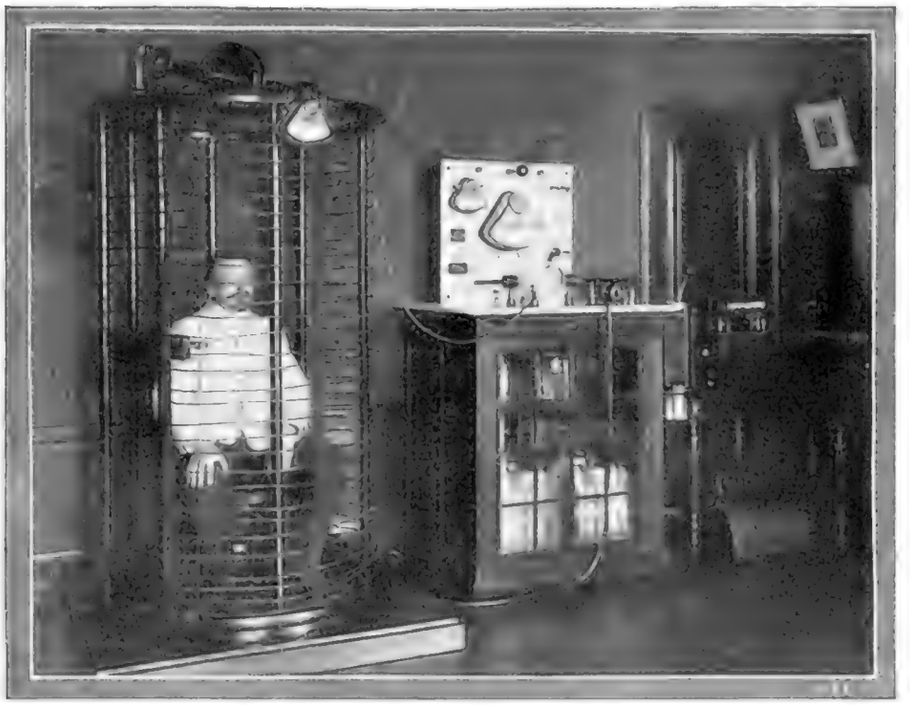
Electricity and Life

The Uses of High-Frequency Currents in Medical and Lecture Work

By FREDERICK FINCH STRONG, M. D.
Lecturer on Electro-therapeutics, Tufts Medical School, Boston

(Third Article)

THE phenomena of high-frequency currents offer us a fascinating field from which to select experiments for public lecture demonstration. In his lectures on *"The Realms Beyond the Senses,"* the author has used high-frequency phenomena to demonstrate the existence of force and matter beyond the range of human perception. In *"The Science of the New Age,"* he has employed similar means in calling attention to the fact that the investigators of to-day are leaving the crude matter of earth and are dealing more and more with *Etheric Force* —and with matter of a *super-gaseous* nature. The scientist of the future will have to provide himself with instruments far more delicate than anything hitherto dreamed of or else he will develop supernormal powers of perception by the manifestation of faculties already latent in the human organism.



Hardening of the Arteries—Most Dreaded of Ailments in Later Life—Is Successfully Treated By Placing the Patient Within a Wire Cage, Thru Which High-frequency Currents Surge at a Frequency of 600,000 Cycles Per Second: D'Arsonval's Method.

For the traveling lecturer who wishes to employ high-frequency currents in his work, the large resonator described in the last issue of THE ELECTRICAL EXPERIMENTER may prove somewhat cumbrous and difficult of transportation. Those who wish a lighter, more compact apparatus may use the small resonator shown in Fig. 1.

It is quite small, yet it sends out streamers two feet in length, and may be operated by a ½ K.W. "wireless" (step-up) transformer. With this little apparatus beautiful luminous effects may be obtained—as, for example, by connecting the terminals with a tin-foil star glued to a sheet of glass; with a suspended umbrella (opened); with a long wire running out over the lecture hall, etc.

For each of these experiments different tuning will be necessary—the series inductance coil being adjusted to balance the different capacities added to the resonator terminal.

This little resonator is made by winding 600 turns of No. 30 triple cotton covered wire upon a shellacked paper cone, 12 inches in diameter at the bottom, 5 inches at the top, and 14 inches high. It is a difficult matter to insulate this small coil as the turns of the winding are very close together; it can be done, however, by the use of from six to eight coats of *Armalac*. The primary coil is a ring, 18 inches in diameter, formed of five concentric turns of thin copper ribbon 1 inch wide. The exciting apparatus is the same as that described in the last paper in connection with the large resonator, except that a ½ K.W. transformer is used instead of the heavy 1 K.W. (See Fig. 2.)

The writer also employs a standard Clapp-Eastham ¼ K.W. Tesla coil excited by the same apparatus (see Fig. 3). Connected with two parallel upright wires the spark from this coil will run up and repeatedly reform again at the bottom, producing a very spectacular effect (Fig. 4).

Another brilliant experiment can be performed with two large glass flasks (ordinary carafes or water-bottles will do). One is filled with water containing a few drops of *fluorescein* solution—(a coal tar dye)—the other with water to which a small amount of *bi-sulfate of quinine* has been added; the bottles or flasks are placed about six inches apart and a wire from the Tesla coil terminal inserted into the solution in each. The current passes down thru the water and the arc takes place between the glass walls of the two flasks. The ultra-violet rays from the discharge cause the water in the flasks to become luminous—the quinine solution with a pale blue light, the fluorescein with a beautiful apple-green. The discharge apparently passes directly thru the glass walls of the flask; in reality, of course, the current passes by *induction* rather than *conduction*, the flasks acting as condensers in series. (See Fig. 5.)

Photos from Jacques Boyer

The "Effleuve" or High-frequency Brush (or Spray) Treatment Has Proven Highly Efficacious in the Treatment of Nervousness (Nerve and Brain Exhaustion)—"Neurasthenia." American Electro-therapeutists Find It Very Valuable.

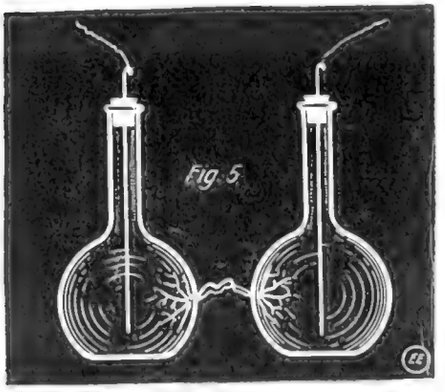
The Use of High-Frequency Currents In the Treatment of Disease.

High-frequency currents are employed by physicians in four principal ways, each adapted to the treatment of certain types of diseased conditions. These are:

1. "Tesla" treatment with vacuum electrodes ("Violet-ray treatment").
2. "Effleuve" or high-frequency spray.
3. "D'Arsonval auto-condensation."
4. "Diathermie."

1. The method most frequently employed applies the Tesla current thru glass (vacuum) electrodes for the relief of local pain or inflammation. The little muscular pumps around the veins—the "vaso-motor system," which keep the blood circulating by withdrawing it from the capillaries and sending it back to the heart—act more vigorously in tissues over which the vacuum electrode is applied. In this manner waste products which cause rheumatism and gout are dissolved and washed away and fresh blood and white corpuscles are brought to infected parts, thus aiding nature in destroying disease-producing germs and their poisonous products.

In most of the smaller high-frequency machines for physicians' use, but one Tesla terminal is provided; a coil of the resonator type being connected to the glass electrode by a flexible wire. The effects are largely local, but the method is of value in relieving pain, swelling and congestion. The writer has always advocated the bipolar method, even for treating purely local conditions. The best results will be obtained from the use of a Tesla outfit of the type described in last month's ELECTRICAL EXPERIMENTER. The patient is to be connected to one terminal of the Tesla coil by means of a metal electrode held in both hands (a piece of thin nickeled pipe will answer, 1 foot long and 1½ inches in diam.). In this way the current is diffused thru the entire body. The vacuum electrode, connected with the opposite Tesla terminal is applied to the skin over the affected part for from five to twenty minutes, a very short spark-gap being used. This method—employed by the writer for years—enables us to obtain the wonderful *vitalizing effect* of the high-frequency currents on the whole body simultaneously, with the local effects from the vacuum electrode.



Startling Experiment With Two Glass Water Bottles Connected to Tesla Coil. The Spark Jumps Between the Glass Surfaces and Illuminates Solutions Within the Bottles.

For the past few years the writer has been in the habit of connecting the Tesla coil with an *Auto-condensation pad* (as used in the "D'Arsonval" and "Diathermic" methods). This is formed of two plates of Bakelite, ⅛-inch thick, hinged to fit the seat and back of an ordinary chair. To the back of each plate is cemented a sheet of tin or copper foil, covered with leatherette. Suitable flexible conductors connect these metal plates with each other and with the Tesla terminal. This folding pad may be used in both "Tesla" and "D'Arsonval" treatment, and is quite as efficient for ordinary use as the cumbrous and expensive *condenser chair* or *couch*.

2. For the "Tesla Effleuve" treatment a brass *bell* electrode is used. This can be made from a common brass oil can, the flat bottom being removed and the resulting hollow hemisphere being mounted on an insulating handle; the discharge occurring from the sharp edge of the brass. The patient is seated on the Bakelite pad, which is connected to the Tesla coil. The opposite terminal is attached to the brass bell electrode and a sufficient number of turns of the inductance coil are placed in series with the Tesla primary to give a full, smooth "effleuve" or purple brush discharge, when the electrode is held from four to eight inches from the patient. By careful tuning a beautiful effect may be obtained. Close examination of this discharge will show it to be literally an electric "brush", formed of thousands of distinct, delicate, purple threads. Upon each of these hair-like paths of light countless millions of *ions* (electrically-active atoms), are being shot from the electrode to the patient at a speed of over 60,000 miles per second; the treated surface is therefore being submitted to a literal bombardment by countless microscopic projectiles which are thrown out in periodic showers from the electrode, once for each cycle of the oscillating current. Two effects are produced—one due to the penetration of the tissues by *ozone-forming ions:* the second to the rhythmic or *periodic impact* of the discharge upon the nerve endings in the skin and superficial tissues. The writer hopes ultimately to produce an apparatus of a frequency *exactly synchronous with the rate of vibration of the sensory nerves;* an "effleuve" from such a coil would produce a harmless and efficient local anæsthesia so that operations could be performed without the use of ether or cocain. The effects obtained from the "effleuve" as now used are stimulating and vitalizing to a marked degree. The nerve endings of the skin may be regarded as sensitive antennae of a complicated radio-system, and any intense sustained vibration to which the apparatus is attuned will be transmitted by them to the receiving station. The effect therefore, is not merely superficial but *systemic* as well. Tuber-

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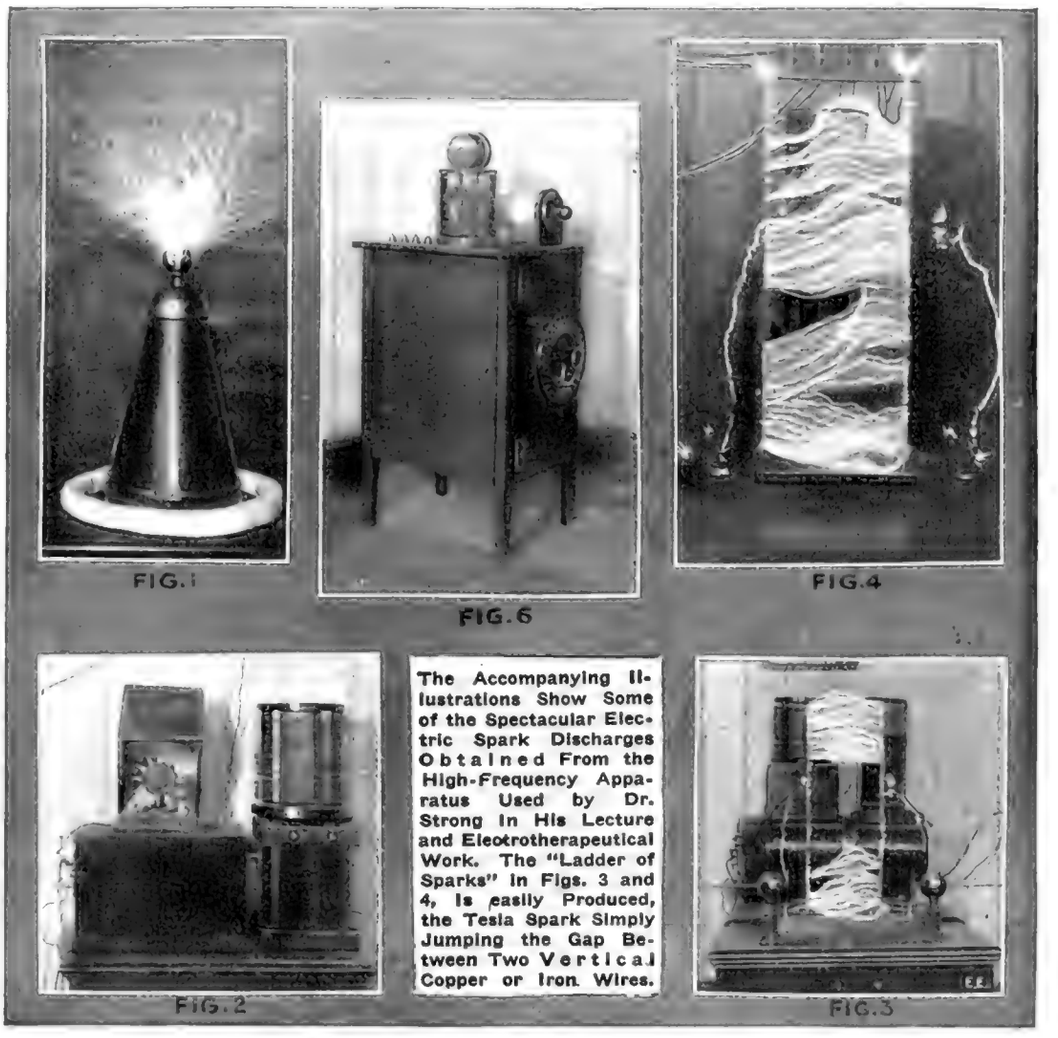


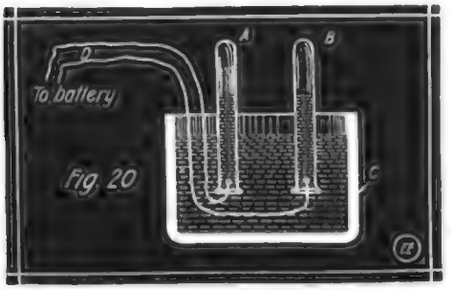
The Accompanying Illustrations Show Some of the Spectacular Electric Spark Discharges Obtained From the High-Frequency Apparatus Used by Dr. Strong In His Lecture and Electrotherapeutical Work. The "Ladder of Sparks" In Figs. 3 and 4, Is easily Produced, the Tesla Spark Simply Jumping the Gap Between Two Vertical Copper or Iron Wires.

Experimental Physics

By JOHN J. FURIA, A. B., M. A.
Instructor in Physics and Science Master, Riverdale Country School

HYDROSTATICS.
LESSON FIVE.

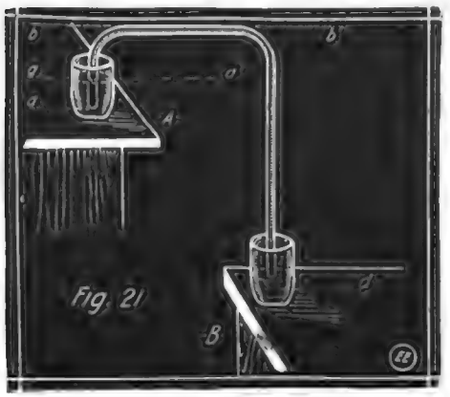
WATER is so plentiful, and we are accustomed to use so much of it, that very few of us ever stop to think what a great part it plays in our daily lives. It is without doubt an absolutely indispensable sub-



A Small Battery and a Couple of Test Tubes or Bottles, Together with Connecting Wires, Will Serve to Clearly Show How the Electric Current Decomposes Water.

stance. We drink it—we clean ourselves and our belongings in it—our crops depend upon it—ourselves and the fruits of our toil are transported from one continent to another by means of it—practically every manufacturing industry makes use of it. Finally and most important, we swim in it. What would be the use of living if we had no Palm Beach or "the old swimming hole in the creek"? We naturally ask what is water anyhow? One could never guess the answer. Water is nothing more than the result of the combining of two gases—Oxygen and Hydrogen. Oxygen, we remember, is the constituent of the atmosphere necessary to life. Hydrogen is the gas which burned with a pale blue flame in the lesson on "Gases." (See March and April issues of this journal.) The following experiment can be easily performed successfully:

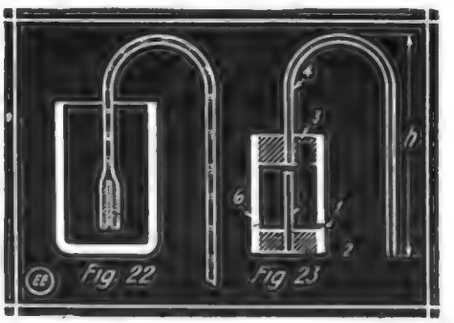
EXPERIMENT 25—(See Fig. 20)—C is a jar nearly full of water to which a few drops of sulfuric acid have been added. (The sulfuric acid is added to make the water a better conductor of electricity. Water alone is not a good conductor of electricity, *i. e.*, is more or less of an insulator, just as glass is.) D represents lead wires from a battery of at



Demonstration and Controlling Factors of the Hydrostatic "Siphon". A Simple and Effective Method of Emptying Tanks and Even Reservoirs When Occasion Requires It.

least six dry cells in series, or from a storage cell or from the house current if it is direct current. If possible the electrodes should be of platinum. A and B are test tubes held in the hand after being inverted full of water and are placed over the electrodes. Immediately, and with a rapidity dependent upon the strength of the battery used, bubbles will form at the electrodes and rise to the top of the test tubes. These bubbles are the result of the decomposition of the water into its constituents. We notice that in one tube the bubbles form more rapidly and that there is always about twice as much gas in that test tube as in the other. Call that test tube "B." After the test tubes have been filled with the gases, raise them carefully without tipping. Insert a glowing match-stick in "A." It is found to burn brightly. This we remember was the test for Oxygen. If a flame is applied to "B" a slight explosion results, which is the test for Hydrogen. Thus we see that water is composed of two parts Hydrogen to one part Oxygen.

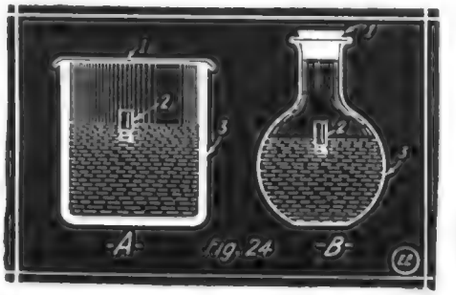
EXPERIMENT 26—(Fig. 21)—Illustrating the principle of the *siphon*. A and B are vessels at different levels, A being higher than B. The vessels are connected by a piece of tubing; bb' indicates the level of the top of the tubing and aa' the level of the water in vessel A. d, indicates the level of the end of the tubing. If the tube is placed in position as indi-



Two Forms of Automatic Siphon. Details for Constructing the One on the Right Are Given Herein.

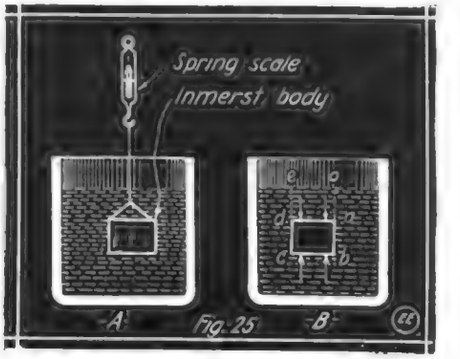
cated in the figure, and A contains water (or any liquid) at a level aa', nothing happens. If, however, the tube is filled with water before it is placed in position, the water begins to flow from A down to B. The siphon will also act if the tube is placed in position, and if one sucks at the lower end; for this is equivalent to filling the tube with water. The explanation of the action is as follows: The upward pressure in the short arm of the tube, is due to the atmospheric pressure (discust in the last two lessons). In the tube ab, this pressure is equal to the atmospheric pressure *minus* the downward pressure due to the weight of the column of water ab. The upward pressure of the tube at b' is the atmospheric pressure *minus* the downward pressure due to the weight of the column of water b'd. The force tending to drive the liquid from A to B is greater than that tending to drive it from B to A. It is greater by the amount equal to the difference in the weight of the columns ab and b'd and hence corresponds to the weight of the column a'd. Evidently if d, were at the level aa', the siphon would not operate; and if above aa', it would operate in the other direction. If the column ab (for water) were greater than 32 feet the atmospheric pressure could not raise the water this distance, and the siphon would not operate.

EXPERIMENT 27—Recently an automatic siphon has been put on the market, and it can be very easily constructed. Fig. 22 shows the automatic siphon in the act of starting. It should be noticed that the tube is filled alternately with bubbles of air and water. This condition prevails only



Apparatus With Which the Principle of the Submarine Can Be Demonstrated. The Small Vial 2, Can Be Made to Perform Many Wonderful Tricks By Pushing Down on Diafram 1, or Squeezing Bottle 3 in "B".

upon starting and shortly after, the water comes out solidly. Fig. 23, shows a home made automatic siphon and all those interested should make one. 6, is a piece of lamp chimney about 3 inches long. 5, is a piece of glass tubing about ¼ inch in diameter stuck thru a rubber stopper 2. 4, is some more of the same kind of tubing past thru the stopper 3. The height h, should be about a foot and a half. 1, is a small hole drilled thru the lamp chimney 6. 5 and 4, should be about ¼ of an inch apart. As soon as our auto-siphon is placed in a liquid it begins to operate WITHOUT OUR FILLING IT FIRST. Thus we see that one made entirely of glass, as are the commercial ones, is very convenient in transferring poisonous liquids and acids, as we need not touch the liquid at all. There is nothing mysterious about this siphon and it is easily explained. When the *bulb* is immersed in the liquid, the liquid rushes in at 1 and at the lower end of tube 5. The liquid rushing in at 1 tends to compress the air in chamber 6. The liquid rushing in at 5 streams up past the gap and thru 4. Hence the outgoing air takes with it some liquid, and, as noted before, we see alternately passing thru the



Proving the "Law of Buoyancy," I. e., That Objects Weigh Less In Water Than In Air.

tube bubbles of air and water. As there is less and less air left in 6, larger and larger quantities of the liquid pass with small bubbles of air intervening, until finally the air being all gone, the liquid

(*Continued on page* 152)

The RADIO LEAGUE of AMERICA

HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.

H. Gernsback, Manager *W. H. Kirwan, Master of Radio Relays*

Denver Wireless Station Wins Prize Loving Cup

By W. H. KIRWAN (9XE),
Master Radio Relays, Radio League of America.

TO a Denver boy goes the honor of winning the trophy cup for the best *Amateur Wireless Station* in the United States. This cup was donated by 9XE to the most efficient and best equipt amateur wireless station in the United States.

We intended to call in a committee to decide upon the merits of the best amateur stations in the country, but station 9ZF in Denver was so far ahead of all other amateurs in sending, receiving, and efficiency, that it would have been a waste of time and energy to have consulted anyone at all.

This station, 9ZF, is known to every progressive amateur in the United States, and is one of the star stations of the Colorado Wireless Association, and of which you have all read in a previous issue of this magazine. The winner is Mr. E. F. Doig, of No. 848 South Emerson Street, Denver, Colo. Mr. Doig made nearly all his apparatus himself, and has been assisted by Mr. W. H. Smith of the Y. M. C. A. Radio Club and the Colorado Wireless Association. Mr. Doig was for four years Master Signal Electrician in the Signal Corps of the Colorado National Guard. He now holds a special receiving and sending license from the United States Government. His equipment, altho not as large as the Government station, is very complete, as you can clearly see from the photograph.

Mr. W. H. Smith, also well known for his skill as an operator, is associated with Mr. Doig and has worked on his night shift at this station. Mr. Doig is also secretary of the Colorado Wireless Association and Mr. Smith is the chief operator. This station will hold this cup for one year, and if they win it again in 1918 it will belong to this station absolutely.

The cup has been properly engraved and you will see a picture in this magazine shortly of the cup holding a prominent place in the Laboratory of Mr. Doig. The Government Call Book gives Station 9ZF as belonging to Captain Smith of the Colorado National Guard, but the license was issued some years ago to Captain Smith; however, the station really belongs to, and was made by, Mr. Doig, as explained above.

A record of messages handled at 9ZF from January 13th to March 18th, 1917, shows that 251 messages were received and sent. A number of them were transcontinental messages from coast to coast. Station 9ZF held a very strategic position in the *Washington's Birthday Relay* of February 24th, 1917, and without the assistance of this station it would not have been possible to have sent the message thru from coast to coast, nor for the return message to have been brought back.

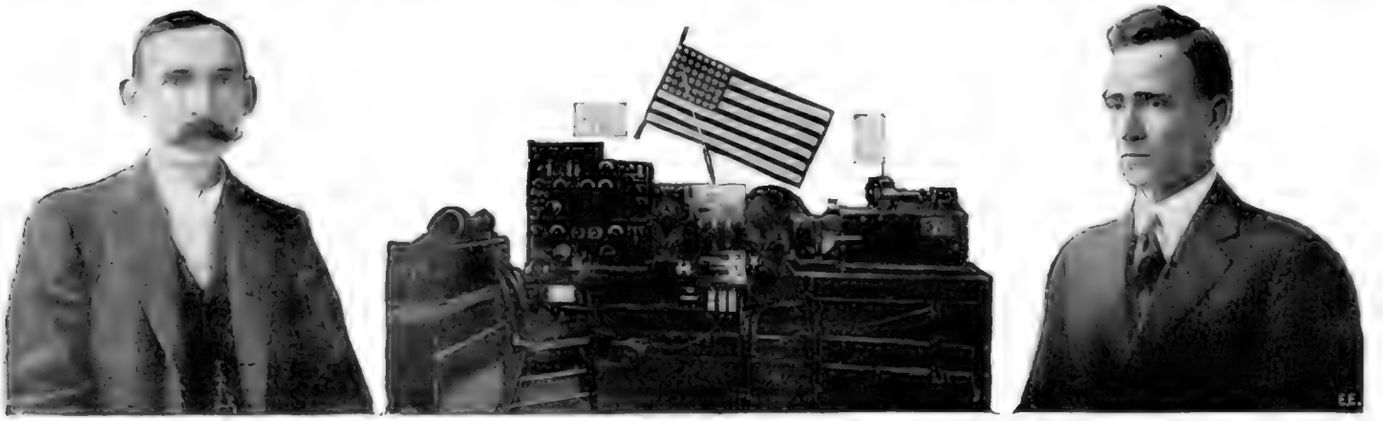
We believe that nearly all of the stations thruout the United States can well pattern their installations, as far as general arrangement and efficiency is concerned, after Station 9ZF. Another point in favor of 9ZF was the fact that, while this station was affiliated with nearly every Radio Club and organization extant, the owners never refused a message, nor did they feel that Station 9ZF was too proud to work with anyone.

In the receiving cabinet is a large loose coupler for reception of long wave stations like WG, GW, SL, OUI and POZ, as well as the Government arc stations. A smaller receiving cabinet is used for the shorter wave stations, including the commercial coast and sub-stations on the spark system. There is also a short wave regenerative receiver, which is used in working with the amateur stations. This cabinet also contains an amplifier which can be used in connection with each of the other sets. There is not much to tell about the Rotary Quenched Gap, as the cut shows just what it is, and there are not very many amateurs but what have had the chance to read about this outfit.

The 1 k.w. outfit which is used mostly, radiates from 12 to 14 amperes on a wave length of 425 meters, and the oscillation transformer is made with edgewise wound copper strip, a type with which you are all familiar, and which is clearly shown in the photograph of the equipment.

There are three towers to Station 9ZF, one of them being 90′ high and the other two 75′ high. One aerial has six No. 12 aluminum wires, 150′ long, and the other aerial has four stranded aluminum cables with 7 strands of No. 14 in each cable, and is 200′ long. Both of these aerials are connected L type.

This station has been working regularly with amateur stations on both the Atlantic and Pacific coasts. Working with 6EA in Los Angeles, Cal., has been a continuous past performance, and recently this station has worked directly with 2PM in New York City. We claim that this is truly wonderful work for an amateur station, and we do not think that there will be any question whatever but that Station 9ZF is well entitled to the prize.



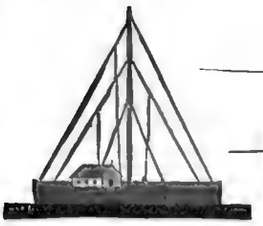
The Trophy Cup for the Best "Amateur Wireless Station" in the United States Has Been Awarded to Station 9ZF, operated by Messrs. E. F. Doig (at Right) and W. H. Smith (Left), of Denver, Colorado.

Since holding the *Washington's Birthday Relay*, which you will all remember was held in the interest of preparedness, with instructions to all sending stations to interest all wireless amateurs in the United States Radio Coast Reserve, Station 9ZF worked the hardest for recruits of any station in the United States.

We have radio clubs in the United States of minor importance, which seem to think that they were the only ones that had a divine right to exist, who have not, with all their membership, done as much good work in enlisting the amateurs under the Navy Department for coast reserve work as Station 9ZF.

All of the stations have been closed by the Navy Department, on account of the war, for the period of war, and we believe it will be some little time before all of us are working again. In order that your interest will not lag in wireless work, and for the benefit of the many amateurs who have enlisted thruout the country and are now assigned to the various warships, we will continue these write-ups each month, with something of interest to them, and something to remind them of home and

(*Continued on page* 143)



RADIO DEPARTMENT

Notice to All Radio Readers

As most of our radio readers are undoubtedly aware, the U. S. Government has decided that all Amateur Wireless Stations, whether licensed or unlicensed, or equipt for receiving or transmitting, shall be closed.

This is a very important consideration, especially to those who are readers of THE ELECTRICAL EXPERIMENTER, *for the reason that we desire to continue to publish valuable articles in the wireless art from time to time, and which may treat on both transmitting and receiving apparatus. In the first place, there are a great many students among our readers who will demand and expect a continuation of the usual class of Radio subjects, which we have publisht in the past four years, and secondly, there will be hundreds and even thousands of new radio pupils in the various naval and civilian schools thruout the country, who will be benefited by up-to-date wireless articles treating on both the transmitting as well as receiving equipment.*

Therefore, and in view of the foregoing explanation, we feel sure that every reader will thoroly understand that altho articles on transmitting, as well as receiving, apparatus may appear from time to time in these columns, he is not permitted to connect up any radio apparatus whatsoever to any form of aerial.—The Editors.

The Naval Radio Operator

SCHOOLS are established at the Navy Yards at New York and San Francisco for the purpose of furnishing Radio Electricians for the fleet from the enlisted personnel of the Navy. After the required sea service has been performed such electricians are transferred to shore duty at Naval Radio stations and other places.

The electrical branch of the schools is divided into two parts. One branch for general electricians and the other for radio (wireless). Applicants capable of passing the examination are enlisted as landsman for electrician (either general or radio) and are detailed for a course at the Electrical School. The pay of landsman for electrician is $17.60 per month while under instruction and in addition he is furnished with a complete outfit of uniform, board, lodging, text books, tools, and materials with which to work. The length of the course is about eight months. Upon completion of the course at the school the men who are qualified are given the rating of electrician third class (radio). In both courses the following subjects are covered: machine shop work, electricity, magnetism, alternating currents, dynamos, motors, and batteries. It also embraces the principles and management of radio stations and installations. The general course covers the application of electricity to shipboard appliances.

Competent operators of the Morse code or men with a sufficient foundation in radio telegraphy may be enlisted as landsmen for Radio Electrician. The applicant must be able to take dictation at the speed of twenty-five words per minute and pass a creditable examination in spelling and penmanship.

The problems in arithmetic include multiplication, division, simple proportion, percentage and square root. Testimonials as to the good character and skill of the applicant as an operator must be presented either from a former employer or from the principal of a school where the applicant has been a student of radio or telegraphy. The applicant must be able to receive about twenty words a minute.

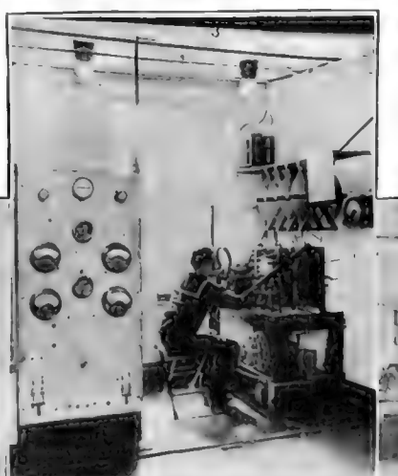
In addition to the above, men holding commercial radio licenses and who pass an additional examination at the Electrical School, Navy Yard, New York, or Mare Island, Cal., may be enlisted as electricians third class (radio). In both cases, whether enlisted as landsmen for electrician or electrician third class (radio), the regular course at the school follows. The opportunity for advancement in the Naval Radio Service is at present exceptionally good and is worthy of consideration by every commercial telegraph and radio operator.

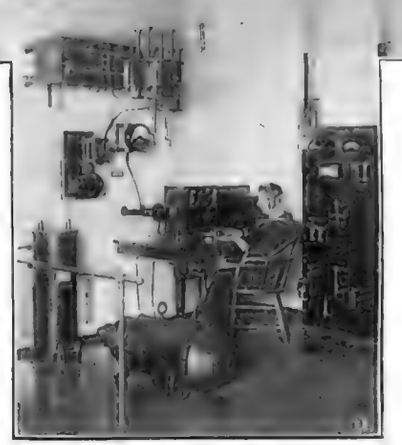
The pay of electricians both general and Radio is as follows: Electricians third class, $33 per month; Electricians second class, $44 per month; Electricians first class, $55 per month; Chief Electricians (acting appointment), $66 per month, and Chief Electricians (permanent appointment), $77 per month. This pay is increased with each enlistment.

The present policy in the fleet is to advance electricians third class (radio) to electricians second class at the end of a year if their proficiency mark is at least 3.2. Electricians third class (radio) serve

(*Continued on opposite page*)

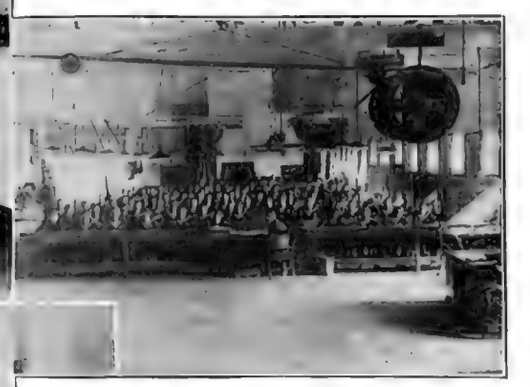
Future Naval Radio Men Learning How to Measure Length and Frequency of Etheric Waves.





Top:—Naval Radio Operator Handling 2 k. w. Transmitter.

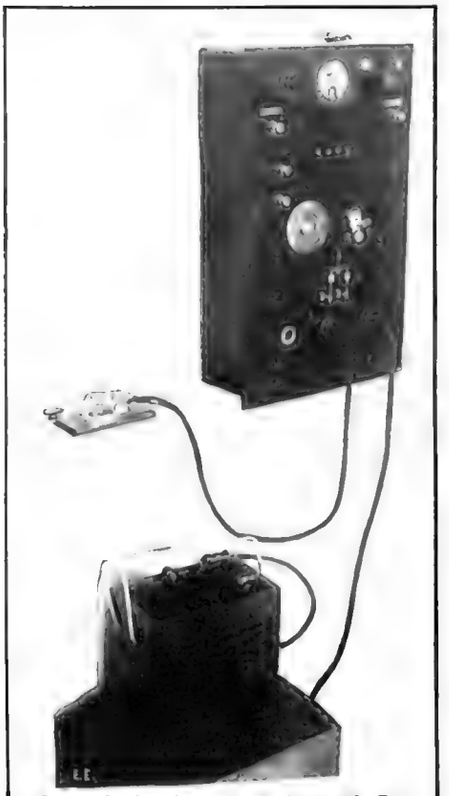
Below:—One of the Up-to-Rate Radio Sets Which U. S. Naval Operators Learn to Handle



Operating Room of Radio Class at the Navy School, Brooklyn, New York.

NEW RADIO TRANSMITTER FOR U. S. "MOSQUITO" FLEET.

The accompanying photograph shows a complete radio transmitter operated from



One of the Latest Designs of Extremely Compact and Light Weight Radio Outfits Intended for "Mosquito" Fleet Service.

a current derived from a storage battery. It was designed for supplying the mosquito fleet with an efficient low power transmitting outfit.

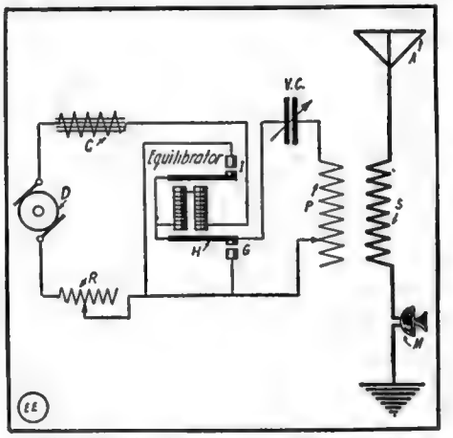
This outfit was developed by A. B. Cole, a New York radio engineer. It consists of a quenched spark gap of the open air type which is mounted on the panel. The sparking surface consists of two large special alloyed discs. The gap is excited by a spark coil of unique design; this is placed behind the panel, its interrupter, which is of the independent type, being stationed on the front of the panel and visible on the center right. The oscillating circuit consists of the usual arrangements; namely, a high tension glass condenser and aerial inductance. A transfer switch is also provided for permitting the receiving and transmitting instruments to be connected at any time desired. This is shown in the upper right hand corner. A hot wire ammeter is also furnished, and this is seen in the upper center of the panel.

The three plugs at the bottom are used for several purposes; the left hand one is employed for connecting the receiving instruments with the aerial; the center one connects the key with the primary of the coil and battery, and the right-hand plug links the storage battery with the supply source. The plug at the upper left hand corner is used for connecting the power source with the test buzzer of the receiving set. A set of binding posts are furnished for connecting the aerial and ground with the set, and these are seen at the upper part of the panel, each being fitted with the proper name-plate.

During some recent tests, the outfit has proven to be very efficient.

THE JAPANESE T. Y. K. RADIOPHONE SYSTEM.

Among the early distinguished workers in radiophony we find that Messrs. Wichi



The Simple Connections Used in the Japanese "T. Y. K." Radiophone System.

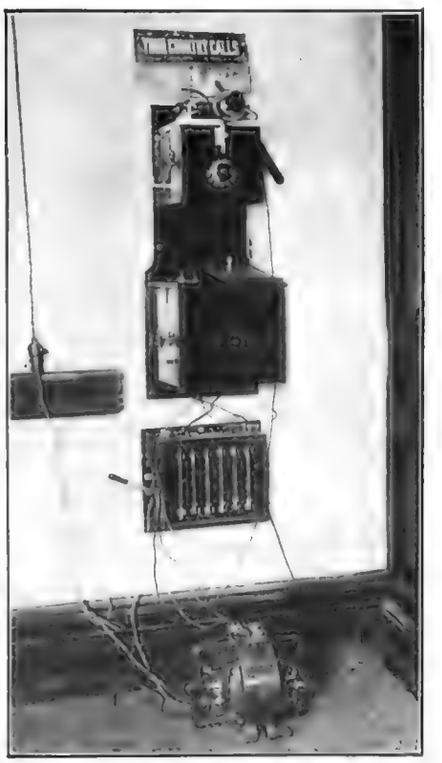
Torikata, E. Yokoyama and M. Kitamura of Japan have done very notable work in this direction, and the system which they have evolved is a radio frequency spark system of unique design, which we herewith describe in detail.

The complete equipment is shown in the photograph and resembles very much an ordinary standard "wall telephone." The transmitting apparatus outside the generator is enclosed within the top cabinet, while the bottom one contains the receiving instruments and aerial control switch. The direct current rotary converter is seen standing on the floor. It runs on a 110-volt direct current source, and delivers 500 volts D. C. for the arc. Protective resistances and choke coil are used, and these are mounted on a separate base; they are seen below the instrument proper.

The transmitting equipment consists of a specially constructed arc, its electrodes consisting of iron and brass. The distance between the stationary and movable electrodes are automatically controlled by means of an electro-magnet so arranged as to adjust the arc terminals in order to keep the oscillatory condition operative. This arc is operated in the open air and the same is mounted on top of the transmitting cabinet. Its connections are made thru the control electro-magnets of the *equilibrator*, as indicated in the wiring diagram. The movable electrode G is controlled by an armature H, which is acted upon by the electro-magnet. The contact I, is broken as soon as the arc has properly started. This break of current at I, is due to the decrease of the arc resistance which permits a large steady flow of current thru the coil, consequently attracting the contact. The arc is shunted with the usual type of oscillatory circuit, P.V.C., namely, the primary of an oscillation transformer, which inductance is controlled by means of the side switch on the left of the transmitting cabinet. A variable high-tension condenser is also mounted in the same cabinet and its capacity is varied by means of a multiple-point switch, indicated on the front. An ordinary carbon microphone is linked in the ground circuit of the secondary of the oscillation transformer, as shown in the wiring diagram. This microphone is stationed on a movable bracket on the front of the cabinet.

The receiving equipment is inclosed in the lower compartment and consists of a standard loose coupled receiver, with a crystal detector. This is placed in a metal housing equipt with a metal door, seen on the left of the case. Adjusting the crystal is performed by a vertical rod protruding from the top cover. Two variable condensers are used and these are mounted on top, while the coupling of the primary and secondary is varied by turning the front knob. A change-over switch is supplied for connecting the receiving and transmitting instruments whenever desired, and the control handle for the same is seen at rear, left-hand corner of the lower cabinet. The primary switch is mounted on the left.

Excellent results were obtained with this system, and a number of sets have been installed in several Japanese land and boat



The Japanese "T. Y. K." Wireless Phone System Is One of the Simplest and Most Efficient Ever Devised. It Greatly Resembles the Familiar "Wall" Type Telephone.

stations. The efficiency in watts per mile of talking range is remarkably high. Also the design of the complete equipment is marked by distinctive simplicity.

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on the large vessels and Electricians second class are sent in charge of the installation on destroyers and gunboats. Men who have served two years at sea, in radio, and who have advanced to second class are eligible for shore duty. The pay and allowances and retired pay of the Navy, and the fact that all men get shore duty, makes the Naval Radio Service more attractive than that of the commercial services. A comparison of the two pays and allowances in the Naval Radio and Commercial Radio favors the former.

The physical and moral qualifications required for entrance to the Naval Service apply in all respects to these branches. If the recruit is unable to complete the course of instruction at the Electrical School because of incompetency or inaptitude he will be transferred, if he desires, to such rating in the general service as he is qualified to fill or he will be discharged from the Navy for inaptitude.

(*Continued on page* 153)

Remarkable Radio Outfit Built By German Spy

A LITTLE black box of mystery, seized recently by the police in the belief that it was nothing more than a modern adaptation of a time worn contrivance for swindling unsophisticated persons out of their savings, was revealed as a clever wireless telegraph outfit, capable of receiving messages from as far away as Berlin.

U. S. Government and Police Experts Were Much Surprised to Find That the Cabinet Here Shown, Which Was Recently Seized with Max Wax, a German Spy, Was Capable of Receiving Secret Radio Messages from Germany.

Police and government experts who examined the mechanism in the box declared it to be as perfect in construction as any they ever had seen. It is (or was) the property of Max Hans Ludwig Wax, a German citizen, and graduate of the University of Berlin. Wax, as soon as he found the police had learned the real nature of the intricate contents of the box, assumed an air of stolid indifference, denied he knew the box could be of service either in sending or receiving telegraph messages or that he knew anything of telegraphy, and asserted that apparently useless bits of paraphernalia contained in the box had been placed there by him merely to make the contrivance "look pretty."

Then, the police say, Wax informed prospective dupes that the little black box contained machinery devised by German scientists for reproducing American banknotes and currency bills. If he would place a one-thousand dollar bill in the "press" inside the box the contrivance would print ten duplicates of that bill. It then was the duty of the "loyal" German, the police say they were informed, to pass the spurious notes off for American gold, so that eventually this country would be flooded with counterfeit notes and persons loyal to Germany would be in possession of most of this country's gold.

Just after Wax was arrested the police learned that he had left the box in a machine shop in New York City. The police finally located the box in a trunk which they said was equipt with a false bottom. It was not until Sergeant Pierce, in charge of the police wireless station, rigged up as part of the scheme for military defence by Arthur Woods, Police Commissioner, looked at the contrivance that it was recognized as a genuine and extremely effective portable wireless outfit.

The box is about two and a half feet square. It is covered with black enamel and has silver handles and brass hinges and clasp. It must have cost at least $800, according to the estimate of experts.

As soon as Sergeant Pierce recognized the use to which the queer arrangement might be put the outfit was rigged up, its batteries were set in motion, and in a moment the hissing sounds and sputtering and flashing sparks that attend the operation of a wireless outfit were in evidence.

Wax persisted, despite the effectiveness of this demonstration, in his assertion that the batteries, tiny dynamo and intricate coils were placed in the box by him to make the apparatus "look pretty." Eventually he said he intended to use them to give color to a motion picture scenario he intended to write.

Persistent questioning, however, drew from Wax, according to the police statement, the admission that he, having bought the materials, the box and its outfit were put together for him by a seaman on board one of the interned German ships lying at Hoboken. He refused to reveal the identity of the man, asserting he knew him only as "Frank" and had met him only a few times.

When the examination of Wax had proceeded that far L. R. Krum, chief radio officer of the federal government for the New York district, arrived at Police Headquarters. He examined the machinery contained in the box carefully and then verified Sergeant Pierce's declaration that it was a wireless outfit of great strength. He agreed with Sergeant Pierce that the apparatus was easily capable of receiving messages from as far away as Berlin. Both experts, however, declared the apparatus probably could not be used to send a message much farther than one hundred miles.

Despite the readiness with which Mr. Krum and the police wireless operators were able to set the wireless outfit in motion, many contrivances in the box were a mystery to them. It appeared as if there were three sets of batteries, where only one was necessary. The operators exprest the belief, however, that any one of the three battery sets might have been connected with the rest of the apparatus, so that, even if two batteries failed, there still would be power to keep the contrivance in operation.

The only incomplete thing about the outfit was that the police were unable to find a sending key and a transformer, both of which would be necessary if the machine were to be used for sending wireless messages. Wax, however, is described by persons who stayed in the house where he lived as having been in the habit of carrying a small hand grip. The grip has not yet been found.

After the police were satisfied of the nature of the equipment in the box they asked Wax to operate it. He fingered several parts of the mechanism for a moment or two and finally succeeded in causing a short circuit, which effectually put the whole thing out of commission. The damage, however, can be repaired easily.

In the examination of Wax the police drew from him the statement that he came to this country from Germany in June, 1914.

He denied he had served in the German army, asserting he was rejected for military service because he had a weak heart. Dr. Baker and Dr. Hamilton, police surgeons, were called in to examine the prisoner. They pronounced him an almost perfect physical specimen and said there was no indication that he ever had suffered from heart disease.

Considerable interest was manifested by the police and federal investigators in papers and letters found in Wax's possession. They declared some were written in code. All of them were in duplicate. One of the papers, according to the police, was a draft for $12,000 and another was for 2,300 marks. The latter was drawn on the Deutsche Bank, of Berlin. It was declared by the police that Wax received some of these papers thru the office of the German Consul in this city several weeks ago. The money, the police said they learned, was sent to Wax by relatives in Germany, who the prisoner declared were both wealthy and influential there.

ELECTRICITY REDUCES FIRE HAZARD.

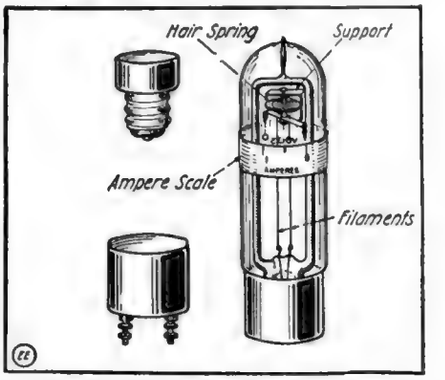
One-fourth of all the fires occurring in Waterbury, Conn., for a year might have been avoided by the use of electricity, according to the report of Fire Chief Heitman.

A NEW VACUUM CURRENT GAGE FOR RADIO.

Herewith we present the vacuum ampere gage, a new Marconi device.

The demand for a small, sensitive, robust instrument suitable for use equally on alternating and continuous current circuits is not new, and inventors have made many attempts to satisfy it.

The instrument is designed primarily as a maximum current gage to indicate the condition of syntony in wireless circuits, and may be employed as a substitute for a *thermo-junction and galvanometer combination* in the measurement of wave lengths and decrement. The principle involved is that of the bifilar suspension, one pair of the filament ends being fixt, and the other pair attached to a pivoted arm, the



By Placing the Delicate Moving Parts of This High Frequency Current Gage in an Evacuated Bulb the Action is Made More Stable and Reliable. It Can Be Used with a Wave Meter to Measure the "Decrement."

rotation of which is controlled by a spring acting against the tension of the filaments. When a current passes thru the filaments, heating them and causing them to elongate, the arm takes up a new position and the angular displacement as indicated on the scale is a measurement of the current.

The movement is enclosed in a glass bulb exhausted of air. The sensitiveness is thus greatly increased, and the movement protected against damage and preserved from dust or corrosion.

The drawing shows quite clearly the construction of the little instrument, which is made up in such a way as to resemble an electric lamp. In one form the bulb is attached to a brass cap with projecting pins identical with that used on standard English lamp bulbs, and the size of the instrument can be gaged by noticing this feature in the drawing.

The variation in zero which is characteristic of hot wire instruments in general is negligible in this type of instrument, and the natural damping renders the movement especially dead-beat.

The instrument, suitably calibrated, may also be used as a low reading volt-meter or ammeter, or as a shunted ammeter. The normal resistance of the commercial type of vacuum instrument is approximately 12 ohms.

Enclosing the working parts in a vacuum has enabled the makers to place on the market an instrument which should prove of great general utility on account of the fact that, at a reasonable cost, it is possible to provide the means of measuring direct and alternating currents of the order of .01 amp., without sacrificing any robustness of construction. The small size makes it a matter of no particular difficulty to insert the instrument in a circuit where no previous provision has been made for a measuring instrument.

With a wave meter using the new vacuum gage the wave-length of the primary circuit of a 1½-kw. set can quite easily be read when the wave meter is held with the plane of its inductance coils parallel to that of the primary of the oscillation transformer at a distance of two to three feet. The noise of the spark, which often hinders the reading of a wave meter by means of a crystal and telephones, in the case of the vacuum gage gives no trouble, as the variable condenser has simply to be rotated until the pointer of the gage gives the maximum reading. In this way circuits can be tuned rapidly as well as accurately.

MISS WINIFRED DOW A RADIO ENTHUSIAST.

Herewith find picture of my radio experimental outfit. My receiving set consists of a Murdock variable condenser, an Audion and variometer.

With this set I hear the calls of KPH; KPA; NPC; NPE and of course all Amateurs in this vicinity.

At the present time I am using only a spark coil and dry cells for transmitting but have a 1 kilowatt set nearly complete.

I thank you in advance for the interest you have taken. Wirelessly yours, Winifred Dow, Tacoma, Wash.

Among the Girls "Radio" Has Now Become a Promising Vocation. At Least Miss Winifred Dow, of Tacoma, Wash., Seems to Think So.

There are lots of worse jobs than that of Radio operator for Uncle Sam. Besides, he pays you while learning. Why not inquire about it? Both women and men are eligible.

MRS. CANDLER AN ABLE RADIO OPERATOR.

Mrs. Candler of St. Marys, Ohio, says, "I surely am very much interested in wireless and not only interested but have been operating our set ever since it has been in existence. I now hold a first grade commercial license. The first photo of our set was sent you last year by '9XE' and appeared in the EXPERIMENTER in connection with the report of the *Washington's Birthday Relay* in the May, 1916, issue. This year our station (8XH) again took prominent part in the *Presidential Relay*, being a prize winner. We have been subscribers to the ELECTRICAL EXPERIMENTER for more than a year."

There Is Now an Opportunity for All Radio Women. One of the Best Qualified Operators Is Mrs. Chas. Candler, of St. Marys, Ohio.

PHILADELPHIA'S NEW RADIO STATION WILL SEND THREE-FOURTHS WAY AROUND WORLD.

Preliminary work on construction of one of the most powerful wireless stations in the world has begun at the Philadelphia Navy Yard, according to an official announcement made recently. The construction of a hangar which will house eight battle hydroairplanes also is under way.

The new wireless station will have a sending radius of approximately three-fourths of the distance around the globe, making possible direct communication with the Philippines and other insular possessions of the United States. The aerial structure will be more than 700 feet high.

"THE CRUISE"—A RADIO STORY. By MARGARET L. CAMPBELL.

Early in August, 1916, I transferred my wireless set from my radio station to my father's new sixty foot yacht, the Wahama. She is a flush deck cruiser with all modern improvements and powered with a large four-cycle gasoline engine. She also has two masts about thirty-five feet apart, which I used to support my aerial. There is a large cabin, ten by twelve feet in size, in which I installed my transmitting and receiving apparatus, which consists of a two inch spark coil, two Leyden jars, helix, spark gap and key. Also, two variable condensers, loose coupler, tuning coil, loading inductance, Ferron, galena and silicon detectors mounted upon a movable cabinet.

Miss Margaret L. Campbell, of Rockport, Mass., Has Long Been a Radio Enthusiast and Has Operated the Apparatus Shown on Frequent Trips Made on Her Father's Yacht. She Has Achieved a Distinct Success with Her Station, Having Become Thoroly Conversant with All Radio Matters.

One of the interesting cruises made last summer was with a company of Marine Boy Scouts of which my father is the commander. We sailed along the coast of Massachusetts Bay, visiting various harbors and spending several days in Marblehead harbor during the festivities of "Marblehead Week," when the great racing events of that notable yachting center are held.

The harbor was filled with yachts of all types and age, from the majestic steam yacht of the millionaire to the small sailing dory of some aspiring youth. I was surprised to find how few of these boats were equipt with wireless apparatus, also how few of them so equipt appeared to be using their apparatus or even listening in. I held conversation with some interested amateurs on shore.

We did not send or receive any "S.O.S." calls, but did have occasion to render timely assistance to a motor boat whose engine had broken down out at sea and towed her to a place of safety before a severe thunder storm broke upon us.

I might say that I detected little difference in the workings of my apparatus aboard the boat as compared with the same on land.

I found my set to be of the greatest service in the evening when the crew gathered about to get the *time signals* and the news of the day.

WIRELESS TELEGRAPHY ON BRITISH SHIPS.

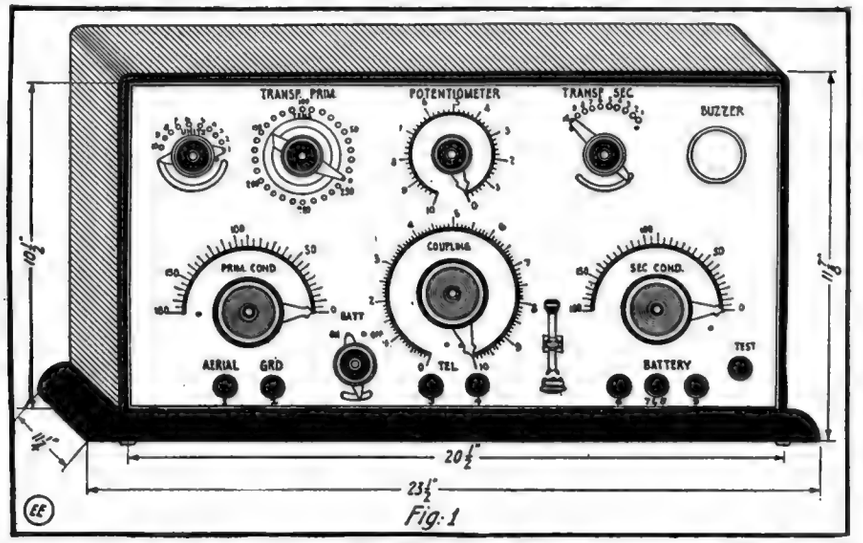
By an Order in Council, issued on July 28 last, every British ship of 3,000 tons gross or upwards is required to have a wireless installation.

The Marconi Type "106" Tuner

By WORTH MacKNIGHT

THE receiver consists of a type "106" tuner and a crystal detector. This receiver consists of a variable inductance primary circuit. One end of this inductance is connected to the antenna thru the antenna switch. The other end of the inductance is connected to the ground thru a variable condenser, which can be short-circuited or thrown into circuit at will. The secondary circuit is so constructed that its inductance may be varied, and also its inductive relation with the primary circuit can be changed. A variable condenser is provided, which permits a variation of wave length and also the variation of the ratio capacity to the inductance, while maintaining the same wave length. A battery and potentiometer is provided which permits controlling the current thru the detector. A pair of head telephones is used for receiving the signals. A buzzer is supplied which permits the local excitation of this receiver, so as to determine its condition of sensitiveness. A battery furnishes current for both the detector and buzzer.

Fig. 1 is a front view of the type "106" tuner and shows the exact position of the different switches and parts for its operation.



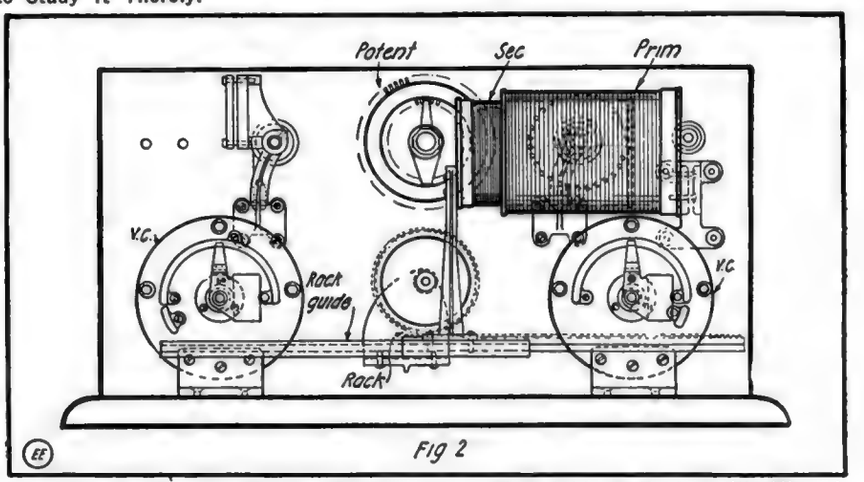
Front View of the "Marconi" Type 106 Radio Receiving Cabinet. Radio Students Will Find It Beneficial to Study It Thoroly.

The switches marked *Transformer Primary* are for the purpose of varying the amount of inductance in the aerial circuit. The switch marked *Units* varies the inductance in *one-turn* steps. The switch marked *Tens* varies this inductance in *ten-turn* steps. The *Primary Condenser*, when in zero position, has a minimum capacity. If this condenser is turned beyond the 180 degree mark, it automatically short-circuits itself, so that the aerial circuit will have no series capacity in it. The terminal marked *Aerial* is connected to the antenna switch. The terminal marked *Ground* is connected to the ground. When this primary circuit is connected to the aerial and ground the circuit is as follows: The aerial is connected to one terminal of the inductance, so that by varying the transformer primary, a greater or less amount of inductance can be inserted between the aerial and ground. This either increases or decreases the natural period of the primary or aerial circuit. It is necessary, therefore, to make these adjustments to bring the circuit in tune with the received signals. If the wave length of the received signal is shorter than that of the aerial circuit, it is necessary to insert the primary condenser in the circuit. This has the effect of shortening the time period of this circuit. The secondary circuit consists of a variable condenser marked *Secondary Condenser*, and a variable inductance marked *Transformer Secondary*.

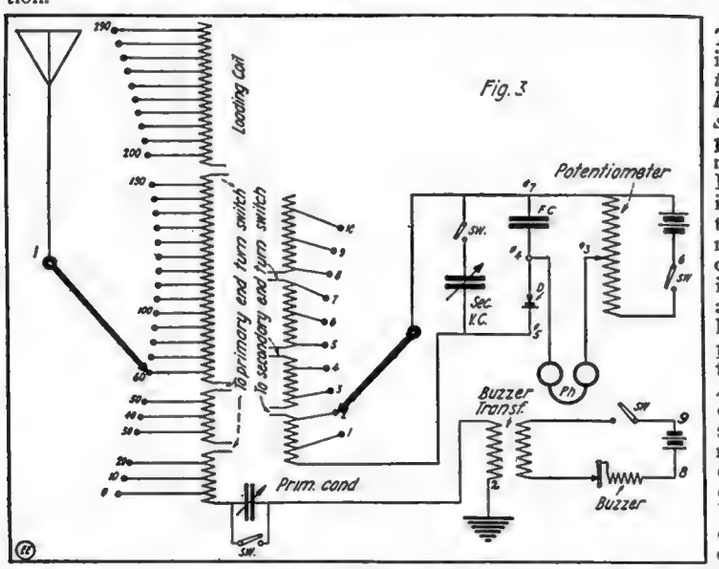
By varying either the transformer secondary switch or the secondary condenser, this circuit can be tuned to the wave length of the incoming signals. It is also possible to vary the ratio of capacity to inductance, while maintaining the same wave length adjustment. It is often found to advantage to vary this ratio. The handle marked *Coupling* is for the purpose of varying the inductive relation of the primary circuit and the secondary circuit. After these circuits have been tuned to the incoming signals, the coupling should be varied until a maximum response is found. The handle marked *Potentiometer* varies the current thru the crystal detector. The detector is situated between the coupling and condenser handles. A switch marked *Battery* is provided, so that the crystal may be used either with or without the battery. A buzzer is mounted on the front of the panel and is operated with a button marked *Test*. Terminals are provided to connect to the battery; they are marked *Battery*. Two terminals are provided for connecting in the telephone receivers, and are marked *Telephones*.

The internal as well as the external connections of this receiver are shown in Fig. 3. Fig. 2 is a back view of the panel.

This hook-up is of interest to all radio amateurs and students who expect some day to become commercial operators. Among other things, note that the buzzer test is linked up with the aerial-ground circuit inductively by a two coil transformer. Note how the secondary coil is moved in and out of the primary by a rack and pinion arrangement, giving great precision to the coupling adjustments as well as rotary control.



Front View of "Marconi" Type 106 Radio Receiving Cabinet, Equipt with Mineral Detector and Loose Coupler.



Hook-Up for Complete "Marconi" Type 106 Receiving Set, Showing Inductively Coupled Test Buzzer.

The How and Why of Radio Apparatus

NO. 4—SPARK GAPS.

From time to time we will describe one particular instrument used in either the radio transmitting or receiving set, explaining just how it works, and why. We have received so many requests from new readers asking for such explanations, that we have decided to publish this matter in serial form. In the course of several issues all of the principal transmitting and receiving apparatus will have been covered. The subject for the fourth paper is the SPARK GAP.

THE spark gap forms one of the most important parts of any oscillatory circuit, and this proves particularly so in radio transmitting circuits, where everything must be designed to realize the utmost efficiency. This means careful and scientific design at every turn, and it takes into consideration such important topics as the proper dissipation of the heat produced in the gap; the proper arrangement of the gap to give the desired tone, and a number of other vital points.

The part played by the spark gap in an oscillatory circuit is to allow the condenser in this circuit to charge to the required voltage, and then to break down and permit the charge stored in the condenser, to surge back and forth across the gap in the form of sparks, until all of its energy is dissipated. For several reasons the ideal spark gap would be one which would insulate perfectly, or be *non-conducting* during the time when the condenser was being charged, and conducting perfectly, while the condenser was discharging.

The nearer these requirements are fulfilled in any spark gap, the more efficient will this piece of apparatus perform its function. While the discharge is passing, the resistance of the gap depends upon two factors: the resistance increasing markedly with the length of the spark, and decreasing rapidly with the oscillatory current, amounting with a half-inch gap to several hundred ohms when a fraction of an ampere passes, and but a small fraction of an ohm when say sixty amperes flow across the gap. If the spark length is above one-half inch, the resistance with the same oscillatory current flowing, can be taken as approximately proportional to the spark length. However, in a condenser circuit, the quantity of electricity is stored up in the condenser, and in consequence, the amount of oscillatory current increases with the spark length. Hence, we find two conditions working against each other, as regards the influence of the spark length on the spark resistance. However, we can increase the amount of current passing thru the gap without increasing the length of the spark, by simply increasing the size of the condenser, and the most efficient circuit for a given amount of power, is that in which there is a moderate spark length with a large condenser.

When the condenser has been fully charged, the spark gap breaks down, and the gap becomes filled with metallic vapor, and for the time being forms a high frequency alternating-current arc. The conductivity of the spark is due to the presence of metallic vapor in the gap. After the discharge ceases, and if this metallic vapor is not quickly removed from the gap, the insulation will in consequence be very low at the time that the condenser is passing thru its next *charging period*, which of course occurs in a small fraction of a second, usually.

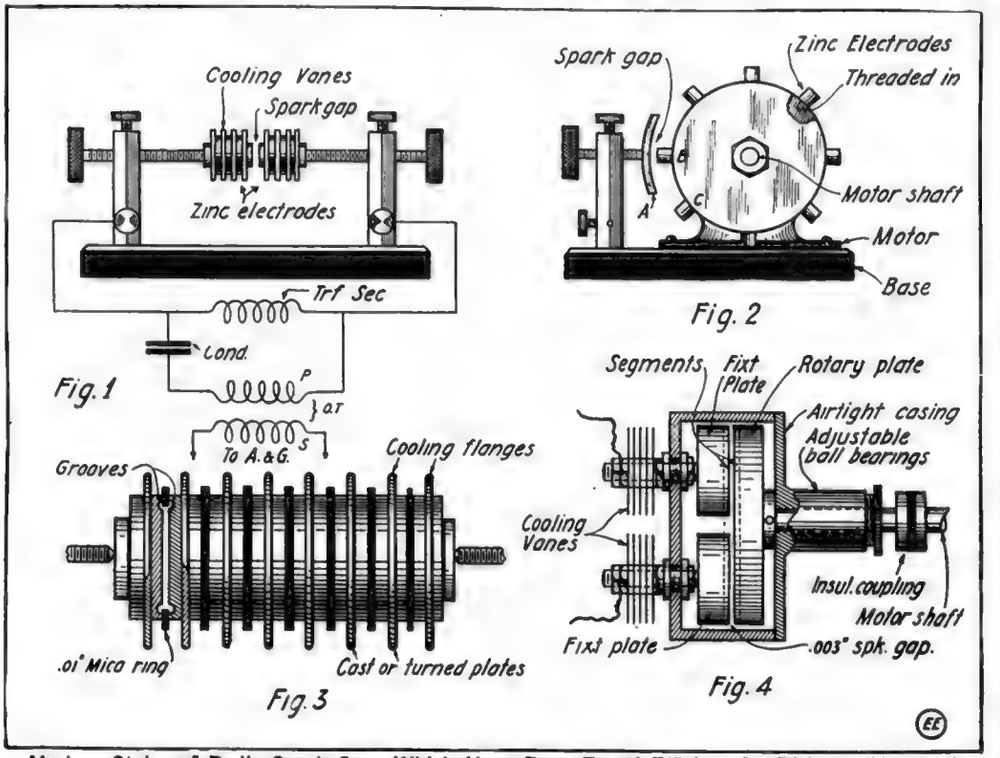
It is therefore paramount that we remove this vapor completely as soon as possible after the discharges of the condenser have ceased. This has been attempted in various ways in the past, such as by providing spark gaps having large cooling vanes attached to the spark electrodes, as in Fig. 1, and also by causing one or both of the spark gap electrodes to rapidly rotate, so as to constantly refresh the air in the gap. This latter condition, which is usually met by arranging a number of small spark electrodes on a rotary disc attached to the shaft of a motor, or to the shaft of a motor-generator in the case of synchronous spark gaps, the spark being caused to jump thru the air between the constantly moving electrodes, and one or more fixt electrodes mounted on the base of the spark gap.

Fig. 2 shows a *non-synchronous* type of spark gap in which the speed of the rotating disc bears no definite relation to the frequency of the alternating-current in the transformer or spark coil. As a spark is apt to occur, or want to occur, at most any indefinite time, it is best with such non-synchronous rotary gaps, to provide a stationary electrode "A," in the form of a segment, having a pitch equal to the distance between two of the rotary electrode points.

For synchronous rotary gaps, driven by a synchronous A.C. motor or by mounting the disc on the same shaft with the motor-generator, as is done in the best types of commercial radio transmitting sets, the fixt electrodes need not be any larger than a single electrode point on the rotary disc.

One of the most efficient spark gaps used very successfully by commercial stations and also by numerous amateurs, is the *quenched* gap illustrated at Fig. 3. This gap, which is very well known to-day, is designed on several important basic principles. The foremost of these desideratums is that each gap shall be preferably not over 1/100 of an inch in length, and moreover, that the gap shall be absolutely air-tight. Further, not over 1,000 to 1,200 volts should be applied to each individual gap, and for higher voltage a suitable number of these short gaps are placed in series, as shown in the illustration herewith; two gaps being adapted to 2,000 volts—three gaps to 3,000 volts, etc. The action of this gap has been described at some length in a semi-technical manner by Mr. Charles R. Ballantine in the March, 1917, issue of THE ELECTRICAL EXPERIMENTER. Briefly, the action of the gap is based upon the fact that a small quantity of air is trapt between the spark surfaces separated by a mica ring of proper thickness. After the first few sparks have past the oxygen in the trapt air is burned up, resulting in a partial vacuum in the gap. This conduces to the rapid quenching thereafter of the spark discharges, due to the condenser, and gives rise to a very ideal set of conditions for the entire radio transmitting circuit. This is because the oscillations in the spark gap-condenser circuit are cut off after the first few beats or sparks, but the oscillations induced in the aerial-ground circuit are left free to oscillate for a longer period. This prevents the reaction of free oscillations in the spark gap circuit upon the aerial or secondary circuit—a condition which is invariably found in ordinary radio transmitters fitted with a plain fixt spark gap, and a condition which mitigates seriously against the best efficiency of such an equipment. The quenched spark gap usually consists of a number of these small gaps as above described, which are placed in a suitable frame so that considerable me-

(*Continued on page* 153)



Various Styles of Radio Spark Gaps Which Have Been Found Efficient for Different Types of Sets. The Rotary Quenched Gap, Fig. 4, is One of the Best for Small and Medium Power Sets Operating on Low Frequency Circuits.

THE CONSTRUCTOR

The Clock Craze

By Thomas Reed

BEING cooped up in a flat, late years, I've had to give up experimenting. Mine's a fine flat, as flats go—all modern conveniences, two kinds of cold water as the fellow says, and a fire-escape with a sparrow's nest on it; even a little safe let into the wall, big enough to hold most of the Wiff's diamond tiaras if you pack 'em tight. Yes, it has all the conveniences but one, and that's the only one worth having—a workshop.

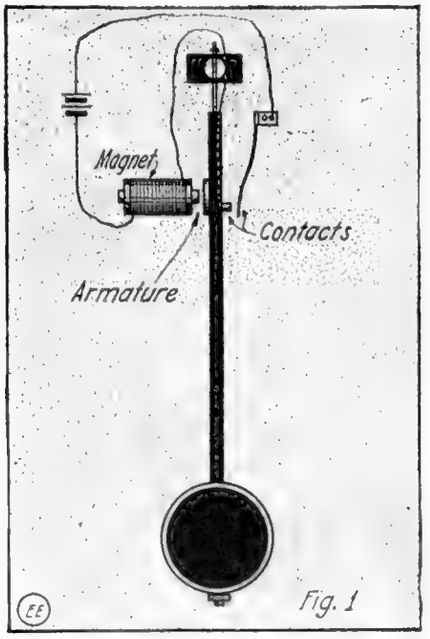


Fig. 1. Attempt No. 1 in Electric Clock Research as Tried Out by the Author—Did It Work? Read the Accompanying Text If You Think So, Bugs.

The nearest I can get to it now is reading the good old ELECTRICAL EXPERIMENTER. When she blows in, I sop her up from front cover to back—every word. Advertisements and all. Well, I'll say so; and I'm not the only one that does it, eh, Bugs?

One place I always stop and smile, and that's the heading "How-to-Make-It Department." I guess my department is the "How-*Not*-to-Make-It." Usually e v e r y-thing I started went wrong the first time; but the finding out why it wouldn't work, and making it over till it would, wasn't the worst fun in the world. In fact, I think it was the best. No fun simply copying.

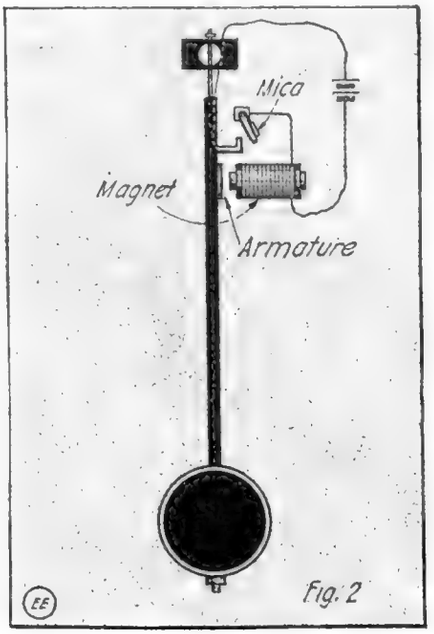
When it came to the electric clock, though, that nearly beat me. There's a thing that looks easy, and isn't; yet it's simple enough once you're wised up.

I was sort of forced into the clock craze. You see, our kitchen clock was on the blink. Father didn't blame it—good old clock, he said, it had served him faithfully twenty-five years, and was worn out. Worn out nothing! I'll bet old Jerome turned over in his grave at that libel, for one of his excellent brass clocks ought to go for 100 years, and only be talking baby-talk then. I knew what ailed it all right; it was so full of my contact-springs, wires, magnets and other junk, that its regular works had become discouraged. But that was a secret between me and the clock, and there were good reasons why the secret was safe with me.

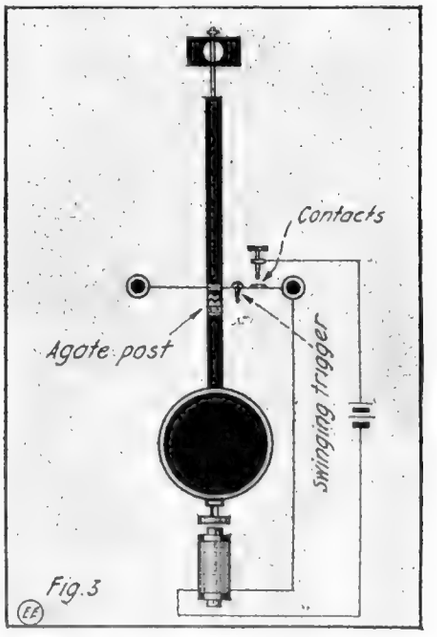
Anyhow, when the clock took to stopping, something had to be done, and done quick, because mother would figure wrong with her Saturday baking, and Mrs. Skillings would get her hot pies out on the window-sill first, which was an awful catastrophe to mother, and made her feel as peevish as the Standard Oil does when a competitor sells a quart or so of gasoline right under its nose.

I had pondered a little on electric clocks, and as I say they looked easy, so I made the family a proposition: for half the price of a new clock I would turn the old one into an electric clock that would go all the time without winding. Father liked the idea because his back got twisted climbing up on a chair to wind the thing, and any clock at all looked good to mother provided it was a going institution. I said this one you couldn't stop if you wanted to; and it would be so accurate that Mrs. Skillings would be running over to ask humbly what the really correct time was. This is known as promoters' language, and is powerful. It clinched the deal. Father handed over the kale with a feeling which if magnified a few diameters would have been enthusiasm.

Everybody (including myself) expected it would be not over two weeks at the outside before I had the clock rigged up and was after Mrs. Skillings' goat with it. I took the old clock to pieces for the last time, pulled out a few superfluous wheels and springs, and inserted a pawl and ratchet-wheel where they would do the most good. Then I started gaily on the electric pendulum that was to drive it. I wished afterward I'd made the pendulum first.



Attempt No. 2, in Electric Clock Design. This Arrangement "Worked Too Well." But the Magnet's Successive Pulls on the Pendulum Accumulated till it Banged Against the Magnet Like Jess Willard Administering a K. O.



Finally the Electric Clock Problem Settled Down to a Resurrection of Hipp's Famous Pendulum. But Oh! that "Agate" Post !X? Likewise Zowie.

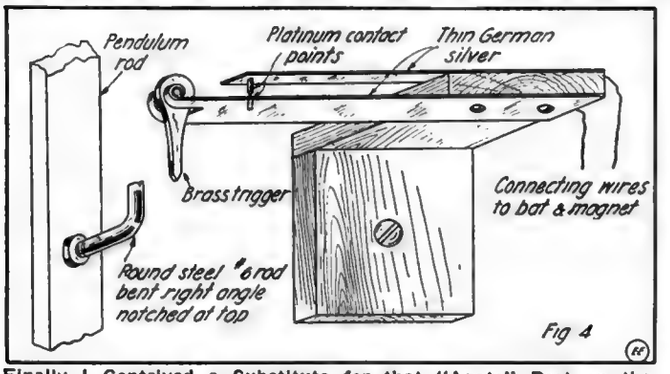
It was a grand pendulum I made—a seconds-pendulum of the due length of 39.1 inches, with wooden rod and a fine heavy bob. I was so cocksure that I polished up all parts as I went along. But when it was done, it wouldn't work.

There were two or three main reasons why. To begin with, it was hung on pivots, like a telegraph key; and the heavy bob set up so much friction there that it would have taken about a kilowatt to drive it. Of course it should have been hung on a suspension spring, which lets the pendulum oscillate while supporting its weight without friction. Bonehead play number one.

Well, I discarded my pivots—tho I hated to, they looked so pretty—and with my pendulum swinging easily from a spring, I looked to see her go. But nix. Good strong magnet, clean contacts, and

all that, but nothing doing. Could anything be wrong with my arrangement? Answer, oui, oui.

You see I had it rigged as in Fig. 1, following the idea of the electric bell. When the pendulum swung over far enough to make contact, the magnet gave a vigorous pull; but unfortunately it checked the pendulum just as much as it pulled it, and the result was nil. The slow, free-swinging pendulum acted differently from the rapid, springy bell-hammer.


Pendulum rod
Platinum contact points
Thin German silver
Brass trigger
Connecting wires to bat & magnet
Round steel 1/8 rod bent right angle notched at top
Fig 4

Finally I Contrived a Substitute for that "Agate" Post on the Clock Pendulum, Relates the Author, and Decided that the Thing to do Was to "Substitute." Steel Proved Excellent—but I Guess a Piece of Cheese Would Have Sufficed.

The two weeks were already up, and mother was beginning to peeve, because meanwhile Mrs. Skillings had put it over her again on the pies; so I hid my chagrin under what I hoped looked like a confident smile and attacked the problem anew.

The next attempt is shown in Fig. 2. I made a flapping contact, metal on one side and insulating mica on the other. This arrangement worked too well, if you get me. The magnet gave a nice pull, and on the back-stroke it let go, all as per intention. But now the pulls accumulated till the pendulum ended by banging against the magnet like Jess Willard administering a K-O. This pendulum thing began to seem decidedly not as easy as it used.

Anyhow, to have it go at all was some consolation. All that was needed now was some arrangement to cut the current off as soon as the pendulum had all the impulse it needed, and switch it on again when more was required. Now I began to appreciate Hipp's pendulum, described in the text-books. In Hipp's device (Fig. 3) the electric contact is made by means of a notched post attached to the pendulum, which normally pushes past a little swinging trigger attached to the contact-spring. As the pendulum loses its amplitude, there comes a moment when the notch in the post just catches the trigger, and then when it starts the other way the trigger is raised and the contact made, the magnet is energized, and gives the pendulum a push. The notch now brushes by the trigger again, until the narrowing swings allow it to catch once more, and the process is repeated. As the battery runs down, the push is weaker and the contact has to be made oftener; but the mechanism does this automatically until the battery is exhausted.

Hipp's rinktum looked effective, if one could only make it; but being a clock-maker, old Hipp had specified agate as the material for his notched post. Agate, he says, just like that: "Take a piece of agate, you know, and put a notch in it." Oh, yes. The only agate I had ever heard of was an agate marble; and it didn't look exactly like easy stuff to make anything of.

Four weeks had now gone by, and the family had lost all their peevishness; that, is, they had exchanged it for black looks and language not calculated to please. I was reaping the usual reward of the sanguine promoter. My stockholders, ignorant of the exactions of science, were clamoring for quick returns on their investment. Stockholders in this mood fall naturally into sarcasm. They say, "Oh, you were just as sure as anything when you were after our money, and now you admit you didn't know what you were doing. Of course you're right on the track of it this time—pooh, pooh! Have it all ready tomorrow morning at breakfast, I suppose. Well, a fool and his money——" all that encouraging stuff. I know just how to treat impatient investors now; but at that time the situation, coming on top of my defeat at the hands of Nature, got my goat, and I'm ashamed to say I declared bankruptcy and quit. Father bought a new kitchen clock, and issued a manifesto (having got an inkling of what ailed its predecessor) that if I monkeyed with its insides to the 100th part of a monk, he would monkey with my outside; and, in the vigorous language of the day, I was not to forget it.

I knew why a prophet is without honor in his own country. Believe me, my home reputation as a budding scientific and business man was badly damaged; to be more exact, it looked like the place where a 42 cm. shell has recently landed. But the clock craze had struck in; and oblivious of everything, in cloistered seclusion behind the barn I pondered upon Hipp and his exasperating agate.

I pondered long before, in a burst of enlightenment, the great truth of Bugdom burst upon me—use some other material, even if it isn't as good, anything at all for a starter. Couldn't I use steel, brass even? it would last long enough to try it anyhow. It makes me laugh now, my great discovery; but do you know that sometimes the getting rid of a fixt idea is the hardest part of an undertaking? Why, I could have used pewter, paper, I guess even cheese if you took it near the rind.

Don't let anyone discourage you, Bugs, by specifying costly and unusual materials. The inventor's describing his rinktum the way it looks after he's got it all babied up in its final Easter dress; but just for a trial you don't need the platinum, Bakelite, Empire cloth, and "S.C." wire—no, sir, you'll find all you really require in the good old junk-box as usual. Me, I grew so independent finally in the matter of materials that I hardly recognized more than two kinds—conductors and insulators!

So, having got the agate out of my head —"solid agate" I guess my old bean was— I used steel for the post and brass for the trigger; and as to durability, let me tell you that after nearly twenty years use I can't with the naked eye detect any wear.

Oh, yes, I made the clock, but I had a long hunt for something on Hipp's principle in a form which the amateur workshop might turn out. After many trials I evolved the form shown in Fig. 4; and I make you free of my invention, Bugs, hoping someone will be interested enough to make himself an electric clock. There's lots of enjoyment in listening to its sedate tick-tock as it breaks up infinite time into the small units we need to make our good or bad use of. Maybe, now that the war will debar us from wireless work for a while, you'll feel inclined to take up this fascinating subject of clocks; and if so, I have many valuable "wrinkles" which I should be delighted to share with you. Only, avoid my experience, and don't make a business proposition of it at first. C-U-L, O-M. .-.-. -.-

NEW RESISTANCE MATERIALS.

A New York concern is now marketing *tungsten* and *molybdenum* in sheet, ribbon and plate form. This development makes these metals suitable for new uses and opens to them a much wider field of usefulness than has heretofore existed. The tungsten and molybdenum ribbon is being made in widths of about ¼ in. (6.35 mm.) and in lengths of several yards. In this shape the ribbons ought to be ideal material for the manufacture of heaters of various descriptions and suitable for high temperatures, the manufacturer points out. The United States Government has already placed an order for plates of these metals for spark gaps on wireless outfits to be used on its Mosquito Fleet.

KINKS FOR THE DRAFTSMAN.

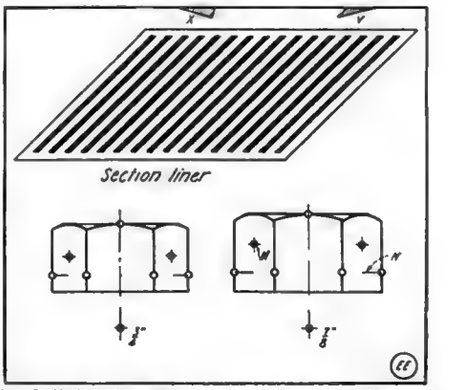
The first "kink" shown is a new section-liner. There are a great number of appliances on the market for this purpose, but the one described will do the same work as the most expensive device, its advantage being simplicity.

It consists of a sheet of celluloid cut as shown. The parts shown in black are cut away with a sharp knife, leaving a kind of grid. To use this section-liner place its base close to the Tee-square and place the pen or pencil into the opening and draw a section-line, following the outline of the grid. Without moving either Tee-square or section-liner, place pen into the next slot and so on.

The two corners "X" and "Y" are cut away to the angle of threads used and these may come in handy when drawing bolts, etc.

The second "kink" will save those draftsmen that are on repetition work much time and trouble. It consists of the following: Draw all those bolts, nuts, washers, fittings, etc., that are used over and over again in numerous sizes on a sheet of tracing cloth and ink it in. Be sure to mark, in the case of nuts and bolt-heads, from where you strike the radii; see point "M"; point "N" shows the height of the bolt head arc.

As most offices use transparent drawing cloth, the standard sheet can easily be slipt under the paper and the outlines traced thru. In the case of many hundred bolts, etc., required, say in details of bolts for pipe lines, etc., the saving of time will be several hours and a much neater drawing will be the result.



A Celluloid Section Liner for Draftsmen and a Scheme for Quickly Drawing Nuts or Bolt-Heads of Any Size.

Contributed by C. A. OLDROYD.

The Influence of Light upon the Contact Potential of Selenium and of Cuprous Oxid

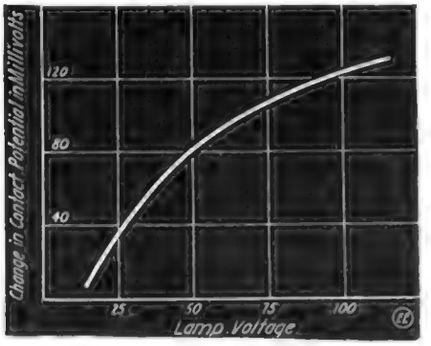
By. E. H. KENNARD and E. O. DIETERICH
Department of Physics (University of Minnesota)

THE change in resistance of crystalline selenium and other light sensitive substances, such as stibnite, cuprous oxid, etc., under the action of light and other agencies, has been explained on the assumption that it is due to a liberation of conducting electrons from the atoms of the material in question.* In other words, the change may be considered as due to a change in the atom itself. If this explanation is correct, then other properties of these substances, which also depend upon inter-atomic forces, should show a variation from light to dark. The authors investigated the *influence of illumination upon the contact potential* of selenium and of cuprous oxid, since this property is one of those mentioned above.

Using, as a check upon each other, two different methods, Figs. 1 and 2 of determining contact potentials, it was found that a change did take place in both substances upon illumination. In the case of selenium, this difference amounted to something over —0.1 volt, several specimens being examined. The value, in the dark, of the contact potential, relative to clean copper, was about —0.4 volt, in the light about —0.5 volt, i.e., the selenium surface becomes more *negative* on being illuminated. With cuprous oxid, of which but one specimen has been examined thus far, the effect is not so great, being about —0.025 volt.

In the case of selenium the effect is very marked, even when light of very low intensity was used, as can be seen from the curve in Fig. 3, which shows the relation between the change in contact potential and lamp voltage. Thus, with a lamp voltage of 25 volts (normal 110) the change amounts to about 0.035 volts, yet at 110 volts at which the intensity of illumination has increased by a factor of about 2,000 over that at 25 volts, the effect is only 3½ times as great.

Until recently the most widely accepted theory of the change in resistance of selenium with a variation of the intensity of illumination has been that proposed by Professor A. H. Pfund, of Johns Hopkins University. According to this theory, the effect of light is in the nature of an *internal photo-electric effect*, i.e., the atoms of selenium expel electrons, the velocity of which is too low to allow their escape from the



Curve Showing Relation Between Light on Selenium and the Contact Potential.

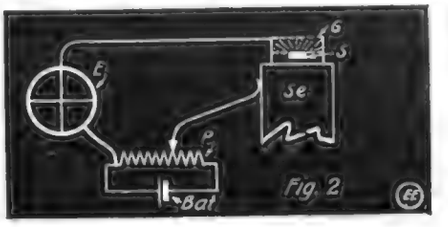
interior, hence they produce increased conductivity. The true explanation, however, does not seem to be as simple as this, for on the above theory, in the regions illuminated, the concentration of *free* electrons would be increased, and one should expect diffusion of these electrons into the darker portions, leaving the part illuminated more *positively* charged. The *negative* sign of the change in contact potential, however, at once rules out the diffusion hypothesis and makes the simple theory mentioned above inadequate. An hypothesis which better fits the facts is that contained in a theory recently proposed by Professor F. C. Brown of the Iowa State University, which assumes that the action of light consists in changing the rate of recombination of conducting electrons with the selenium atoms, or, in other words, it decreases the potential energy of the electrons in the inter-molecular spaces.

* A more complete discussion of this work is to be found in the *Physical Review* for January, 1917. This article prepared for THE ELECTRICAL EXPERIMENTER."

POPULAR DISCUSSION ON THE PRODUCTION OF HELIUM

By Mark Fushman.

In a spectroscopic investigation, Janssen and Norman Lockyer observed in the atmospheres of the sun and many fixt stars, a bright yellow line which could not be associated with that of any known substance. To this new substance they gave the name "Helium." Helium was discovered on the earth in 1895 by Ramsay and

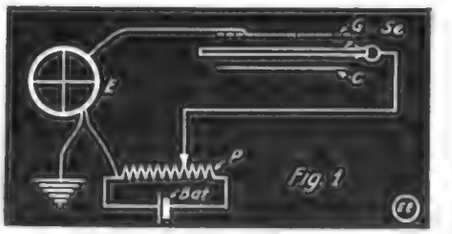


Ionization Method of Measuring Contact Potential. This Method Is Also a Null Method as the Diagram Indicates. S Is a Copper Strip Coated with Polonium, the a-Particles from Which Ionize the Air Above the Selenium, Se, But Do Not Strike the Selenium Surface. G, as in the Other Method, Is a Brass Gauze Connected to the Electrometer.

Travers, who obtained it by heating the rare mineral *Cleveite*. Later on, it was found that this element is a companion to *Argon*. Lastly, it was also discovered in the atmosphere.

Helium has an atomic weight of 4.00 and is monatomic, i.e., that is—the helium molecule consists of only one atom. At ordinary temperatures, helium is a colorless gas; it boils at about 269°C., and by evaporation at a pressure of 0.15 mm., a temperature 1.5 above absolute zero was obtained.

The fact that this new gaseous element occurred in certain minerals was considered very remarkable. A new light was thrown on this subject by the discovery of radioactivity. Radioactive substances are known to emit spontaneously electrons, or particles, as they are now termed. As these particles are emited the substance changes into a new and different element; this is known as the disintegration theory of radioactivity. In looking for a disintegration product, the presence of helium is noteworthy, for helium is found in minerals containing uranium or thorium. Rutherford and Soddy suggested that helium might be a product of disintegration. Ramsay and Soddy obtained thirty milligrams of radium bromid and dissolved it in water. Radium bromid produces hydrogen and oxygen, so these gases were drawn off and there remained a small bubble of residue gas, which was introduced into a vacuum tube and showed the characteristic lines of helium. When a very old sample of radium bromid was



Condenser Method for Measuring Quick Changes in the Contact Potential. The Electrometer, E, Can Be Connected by Means of Suitable Clips, Either to the Gauze, G, the Selenium Plate, Se, or the Copper Plate, C. As Shown in the Diagram the Connections Are Such That, by Means of the Potentiometer, P, the Deflection of the Electrometer Which Occurs When Light Falls on the Selenium Plate Thru the Gauze, Can Be Made Zero, and the Change in Contact Potential Determined. Proper Precautions Are Taken, of Course, to Secure Proper Electrostatic Screening.

used, the residue bubble gave the complete spectra of helium. This experiment showed that helium was produced by radium. Helium is also produced from active forms of *actinium*. This shows also that helium ought to be a common product of both substances.

Radium, owing to its property of giving forth particles, gives forth certain particles which are called alpha particles. In old radioactive material there is a large collection of helium which goes to prove that the alpha particle is connected with helium or rather that an alpha particle is a helium atom. An estimate of the rate of production of helium from radium has been made by Ramsay and Soddy. 1 gram of radium produces daily 0.499 cu. mm. helium gas.

Investigation seems to show that the alpha particles from actinium and thorium are also atoms of helium; therefore we may regard these elements as compounds of helium and some unknown element. It appears that helium plays an important role in the formation of the radioactive elements. It may be that helium, like hydrogen, plays a part as one of the elementary elements of which the heavier atoms are built.

It is supposed that at the center or rather in the depths of the earth, where the pressure is great and the temperature high, radioactive elements are being formed and the deposits of radio-elements now on the earth's surface were thrown up from below ages ago.

CARD INDEXING THE "E.E."

I have a little stunt which I thought might be of interest to other readers, as follows:

I took a small card index that is sold for a recipe file and sold for $1.00 anywhere, and as I read my ELECTRICAL EXPERIMENTER each month, I note on the cards all those things that may be of future use to me, in this way:

Antenna Switch-Exp. Jan., 1917, page 658; then at any time that I want to make anything, I look at the cards and all articles in my stack of magazines are listed there, which saves hunting thru a stack of several dozen magazines for something you have seen, but cannot find.

Contributed by F. C. BROWN.

High Frequency Apparatus and Experiments

By HUBERT A. McILVAINE

MANY experimenters either do not realize the vastness of the high frequency field, or think that they have not money enough to buy the necessary apparatus. It is the purpose of this article to explain the manner of constructing a few simple instruments, and the method of carrying out some simple experiments.

In the first place, a high frequency transformer must be constructed. An Oudin coil will be the best for all-around work, and it may be made in the following simple manner: Procure an ordinary pasteboard mailing tube, about 2½ inches in diameter and 10 inches long, and cover it with a thin coat of white shellac. While this is still wet, wind the tube with fine copper wire, spacing the turns far enough apart to ensure proper insulation. (Enough wire may be found in an old telephone ringing magnet.) Glue this tube upright to a base and fasten three posts on the base. The primary coil may be made of 6 turns of No. 14 copper wire, connected as in the diagram, Fig. 1.

A condenser can be made by coating both sides of old photographic plates with tinfoil, and placing them in a cigar box, to hold them in an upright position. A spark gap of most any type will answer. A 1½ inch spark coil should be used.

When the above instruments are constructed, they should be connected up as shown in diagram, and the apparatus is ready. When the spark coil is operated, a brush discharge of purple light should appear around the free end of the secondary, upper end of coil, with sparks about 2 or 3 inches in length. If a piece of metal is held in the hand, a very long spark can be drawn from the secondary wire, without the slightest shock. If, however, the spark is drawn directly into the hand, a severe sting may result. On the other hand, if a pane of glass is held between the secondary wire and the hand, a spark may be received directly into the hand without pain; the spark, being dispersed or spread out while passing over the glass.

If a person insulated from the ground grasps the free terminal of the secondary, a match may be lighted from any part of the body. A Geissler tube will light up brightly, when brought near the body. This is also a good way in which to treat heart and nervous diseases. If there is any local trouble, a grounded metallic object should be brought near the point to be treated, thus taking out the induced current at this point.

An interesting experiment is to produce an artificial Aurora Borealis. This may be accomplished with a large electric bulb (a 100 watt, burned out one will do), covering the tip with tin-foil. Insulate the bulb

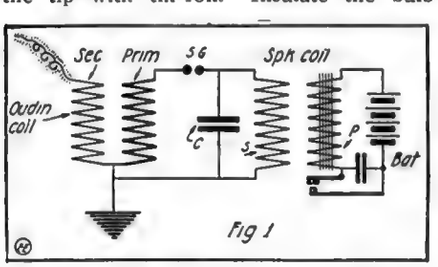


Fig. 1. Proper Connections for Small "Oudin" High Frequency Coil Excited by a Spark Coil or Step-up A. C. Transformer.

from the ground and fasten the screw end to the secondary wire. Place a strong permanent magnet on each side and start the coil. A beautiful auroral effect will form

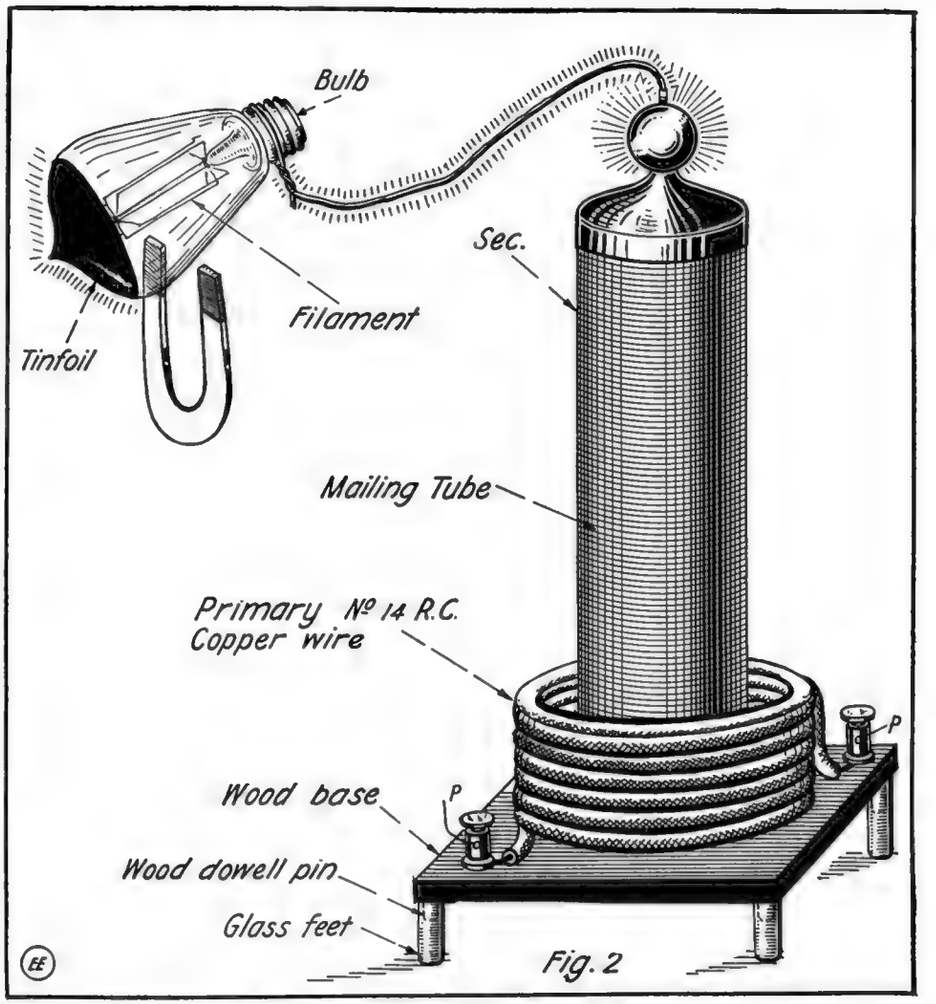


Fig. 2. Manner of Constructing Small "Oudin" Type High Frequency Coil for Carrying on a Series of Interesting Experiments. One of These Is the Artificial "Aurora Borealis," Which Is Produced with the Aid of an Incandescent Lamp Bulb, Having Its Tip Portion Coated with Tinfoil, and Connected as Shown.

inside the bulb. Also, if there are any loose pieces of filament, these will begin to revolve rapidly about the inside of the bulb and will continue to do so for some time after the current is shut off, and each time they touch the glass a shower of sparks will fly in all directions.

A by-product of high tension electrical stress in the air is *ozone*. Ozone is merely electrified oxygen. When a high voltage discharge takes place in air or pure oxygen gas, the atoms of oxygen are "torn apart" and exist in what is known as a nascent state. In this state each atom combines with one other atom, and the chemical affinity of these two atoms is such that, as there is nothing with which they can combine, these atoms pull to themselves and combine with a third atom of oxygen. Thus it is that a new gas is formed. This gas is much denser than oxygen and is many times as active. The smell of ozone is very strong and there seems to be a slight difference in the smell of ozone produced with a static machine and the ozone produced with high frequency current. Ozone is an excellent "germ killer," as it kills all kinds of disease germs on contact. If it is administered properly, and in time, it will cure consumption.

The electric stress about the coil is so great, that immense quantities of ozone are constantly being generated. In order to treat diseases obtain a box which is large enough to contain the coil and still leave enough space (about 4 inches) on each side to prevent the coil from "grounding." Run the coil wires through the box and leave the free end of the secondary about six inches long, so as to obtain good radiation surface. Place a hose in the top of the box and another in the lower part of one side. Paraffin the box to prevent leakage, and put a small window in one side so that the coil action may be viewed. Either air or pure oxygen is taken in thru the lower hose and the ozone is inhaled, or otherwise applied from the upper hose. In fumigation, treatment of coughs, pneumonia, colds, and for many other medical uses, besides oxidation of certain materials, bleaching flour and cloth, experimenting with its use in welding and many other commercial uses, ozone is a most valuable agent.

Taking the high frequency field as a whole, it is well worth while for more experimenters to work with it. High frequency current has the properties of both static and galvanic electricity, besides many properties which neither of the above possess. It will pass over ordinary insulators, such as glass, almost as easily as low frequency current will pass thru copper. It travels over the surface of a conductor and seldom thru it. Its oscillations are

(*Continued on page* 154)

The Problem of Using The Energy in Sunlight

By Prof. I. Thornton Osmond

A RESEARCH PROBLEM AND OUTLINED SOLUTION.

SUPPOSE all the electrical energy used in the world for power, heat and light to be obtained for nothing. How the world would be changed. Energy in electrical form, of limitless amount and absolutely free, is falling over a world provided with apparatus and appliances for the use of electric energy. But the world does not use this constant, exhaustless flood of free energy; it digs coal out of the earth and depends on that for its power, heat and light.

The greatest discovery any experimenter can seek is the *direct utilization of solar energy* as the source of power for the world's work.

The following outline of experimental research may enable some so circumstanced that they can make the investigations, to make this discovery. In this work I seek to obtain energy from solar radiation by causing it to produce ordered acceleration of electrons about, and in, a conductor — electric current.

Problem: — To Obtain Electrical Energy "Directly" from Solar Radiation.

1°. The solution here proposed is based on the following principles: 1. The solar radiation is electro-magnetic. 2. The flow of energy is in the direction of propagation, sun to earth. 3. The periodic action, vibration, is at right angles to the propagation, and is cyclic variation of two vector magnitudes, electric force and magnetic force. 4. Solar radiation produces acceleration in electrons in its path that have a component of motion in a certain relation to it. 5. Acceleration of an electron produces an (opposite) acceleration of surrounding electrons.

2°. The experimental solution is rendered difficult by the great complexity of the solar radiation. Take a small area in a plane at right angles to the solar beam. At every instant there are passing thru this waves of millions of different lengths and periods, and at every instant they are in millions of different phases, and the electric and magnetic vectors in these waves at any instant are in millions of different directions and continually changing at every point.

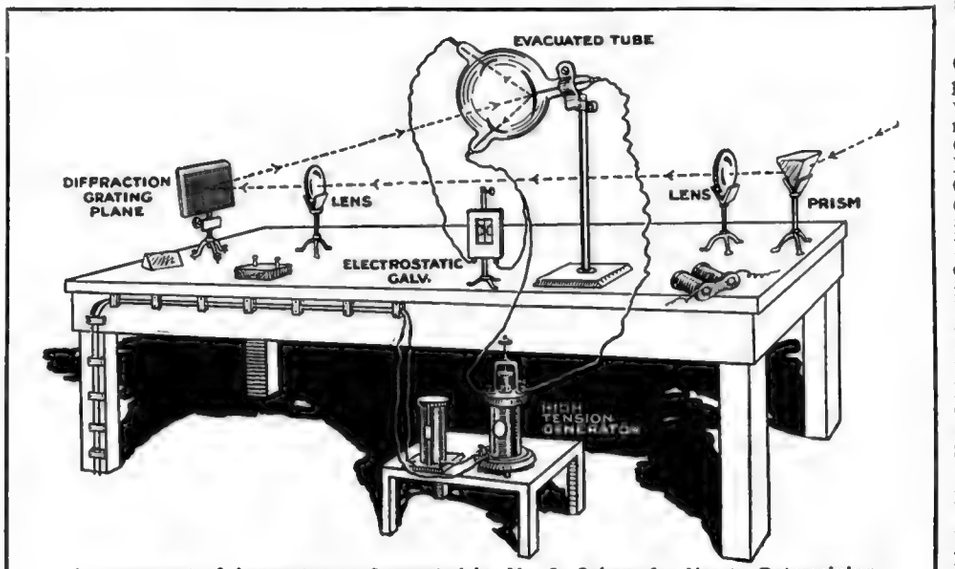
3°. A beam of one wave length or period approximately may be obtained by the use of a prism or a grating, preferably a grating.

4°. A beam with the electric vector confined to one direction may be obtained by the use of a polarizing mirror or a pile of plates; or to two directions, giving elliptic resultant by an additional mirror or a rhomb.

5°. A complex beam, a beam of one wave length, or a beam of one wave length and one direction of electric vector, may be concentrated to a small area, circular or linear, in which, at any given instant, there is but one phase in the focus of a lens, spherical or cylindrical, all waves (of a given length) are in the same phase at any instant.

6°. Two parts of a complex beam, of a one wave length beam, or of a one wave length and one electric vector beam may be made to traverse the same space by the use of a biprism or a mirror in such a way that the intensity at various places at any instant has values that vary from zero to four times that of the single beam.

7°. Take a vessel with walls readily traversed by the solar radiation and that may be exhausted to high vacuum if desired, and produce in it an abundant supply of electrons (as by a filament or wire heated by a current) and bring into this vessel electrodes to receive the radiant energy treated as in 3, 4, 5, 6, and send it thru an external circuit, containing such capacity, induction, and resistance as may be required, and some form of indicator, as a galvanometer, telephone, or wave detector. (The vessel, vacuum and ionizer may not be necessary; possibly the energy of the treated beams can be taken by the electrodes without these.)



Arrangement of Apparatus as Suggested by Mr. S. Cohen, for Use in Determining the Most Effective Energy Components in "Sunlight." The Various Rays Are Focussed from a Diffraction Grating Into a Vacuum Bulb, and Their Magnitude Measured by the Reaction Deflection of an Electro-static Galvanometer Connected Across Two Electrodes, Charged As Shown by a High Tension Arc or Other Generator.

8°. By the various combinations of apparatus, in 10-below, using solar radiation, produce in the vessel the linear focus, or foci, of the different character beams of 3 and 4 above; or produce within it the space variations of intensity of 6 above, with any of the kinds of beams named. Try various relations of variously formed electrodes to the focus, or foci, and to the regions of different intensity; with various ionizing current, as direct, high frequency alternating, or spark discharges of coil or condenser, and various inductances, resistances and capacities in the external, or receiving, circuit—using one or another of the indicators named above.

9°. Apparatus for Proposed Experimental Solution.—1. *Lens* of sulfur, paraffin or synthetic resin, cylindrical, 27 cm., chord, 40 cm. long, 50 cm. focal length; two others, each 22 cm. chord, 40 cm. long, 50 cm. focal length. 2. *Grating,* plane, 34 elements, a+b=1.2 cm., 40x41 cm. inside of frame. Also a curved, cylindrical grating, 100 cm. radius, 32 elements, a+b=1.5 cm. 3. *Fresnel Mirrors,* one 40x40 cm., the other 40x60 cm.; the latter serving for a Lloyd single mirror, if wanted. 4. *Biprism,* sulfur, 25 cm. wide, 40 cm. long; small angles 7°, large angle 166°. 5. *Polarizers,* reflecting metal plate, pile of plates, glass or sulfur; *fine* grating; Fresnel rhomb. 6. The transferring, or receiving, apparatus described in 7 above (which may not be necessary). 7. *Accessory* apparatus, as capacity, resistance, inductance, and indicating instruments.

Wherever wave length enters into the design of these pieces of apparatus it is taken as from 0.6cm., to 1.2cm., as being near the lower limit of waves well above the longest heat waves, *i.e.,* waves producing molecular motion. Greater wave lengths, with corresponding changes in design may be found to give better results.

10°. Apparatus Combined for Experiments, giving various kinds of radiation beams.—1. Grating and Lens, or Lenses; or Lens and Curved Grating. 2. Grating and Polarizer. 3. Grating, Polarizer and Lens, or Lenses. 4. Grating, Polarizer and Ellipsizer. 5. Grating, Polarizer, Ellipsizer and Lens. 6. Lens and Biprism or Lens and Mirror. 7. Grating, Lens and Biprism and Mirror. 8. Grating, Polarizer, Lens and Biprism.

For this work it would be desirable, perhaps necessary, to have a completely metal (iron) inclosed container of the instruments. If a room of this kind is not available, an iron case 2.4 meter (m.) long 0.5m. wide, 0.8m. high will contain any of the combinations of apparatus given above and the transferring, or receiving, apparatus. The mounting of the combination of apparatus should permit following the sun or directing to any point within 90° of it.

An electrolytic process of deoxidation has been patented in the United States by Pascal Marino of London. The object to be treated is made the cathode in an electrolyte containing phosphoric acid. In addition to its normal function of carrying the current, this acid acts as a solvent upon rust without attacking the steel or iron body beneath. It is in this last detail that its chief availability lies, since nitric, sulfuric or hydrochloric acids would not display such moderation. Finally, the phosphoric acid is beneficial in preventing subsequent further rusting.

The electrolyte is made by adding ten parts of phosphoric acid to ninety parts of water, or by adding 10% of the acid to a 10% solution of sodium phosfate.

Due to the advent of the war, we are particularly desirous of obtaining manuscripts describing original and practical "Electrical Experiments." We shall continue to publish Radio articles, but what we need is snappy "Electrical" articles. Be on guard for the enemy—Repetition!

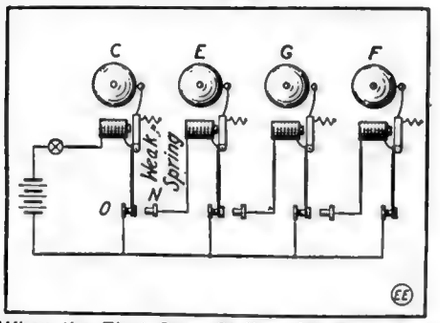
HOW TO MAKE IT

This department will award the following monthly prizes: **First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.**
The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $3.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $3.00

A NOVEL ELECTRIC CHIME.

The accompanying illustration shows an electric chime which I have used in place of an ordinary vibrating bell.



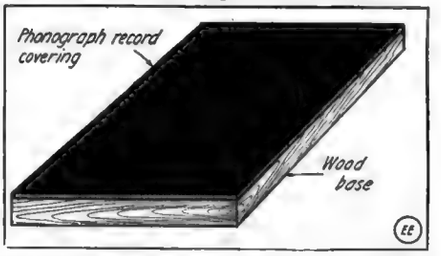
When the First Gong Strikes, Its Dependent Armature Closes the Circuit Thru the Second Gong Magnet "E", Etc.

The bell armature should be lengthened and two contact points soldered to the end. When a button is pushed the armature of bell C is drawn over, striking the bell once. The lower contact then strikes N and throws bell E in circuit. The armatures stay over against the magnet as each successive bell is put in circuit, thus keeping the circuit thru lower contacts complete. When bell F is rung, the battery circuit is broken, and all the armatures fly back. Thus the operation is repeated. The gongs should have different tones to give a pleasing chime effect, and as many bells can be used as desired.

Contributed by A. G. CORKRAN.

"HARD RUBBER" BASES FROM "VICTROLA RECORDS."

Wishing to make a detector and not having a suitable base I procured a piece of oak (any wood will do) and an old phonograph record. I cut the wood and record to the desired size. I then put a thin layer of shellac on the wood and prest the piece of record on it, and left it for a few hours. When it was dry I sandpapered the edges and polished the composition rubber.



Do You Want a Hard-Rubber Instrument Base? Just Cut a Piece of a "Victrola" Record and Glue It to a Wooden Sub-Base.

If the above directions are followed very neat bases can be made by the amateur. If the hole in the record does not allow a large base to be made, cut a circular piece of the composition rubber and plug it up.

Use records that have one side blank.

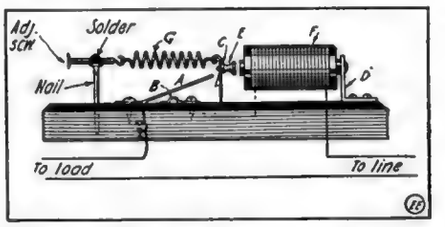
Contributed by HYMAN R. WALLIN.

SECOND PRIZE, $2.00

SIMPLE AUTOMATIC CIRCUIT BREAKER.

The circuit breaker described below is giving efficient service on the switchboard in my laboratory. The pieces A, B, C and D are brass strips; E, is a soft iron screw with two nuts to fasten it to the trigger C. F is an electro-magnet wound with No. 12 silk insulated magnet wire. The core of this magnet was obtained from an electric bell. The spring G, and the adjusting screw are used to regulate the instrument. The connections are as shown. The breaker is used on 110 volt A.C. or D.C. lighting circuit. When the contact A touches the contact B, it is held there by the trigger C. The magnet F is always magnetized to a certain extent but an overload or short-circuit causes the magnet to attract the armature C, releasing the contact A, which breaks the circuit. It is to be manually reset.

Contributed by ALGIE RIGGS.



In this Circuit-Breaker the Armature Normally Holds the Spring "A" Down; an Overload Causes the Magnet to Attract "E", Thus Opening the Circuit.

WALNUT STAIN.

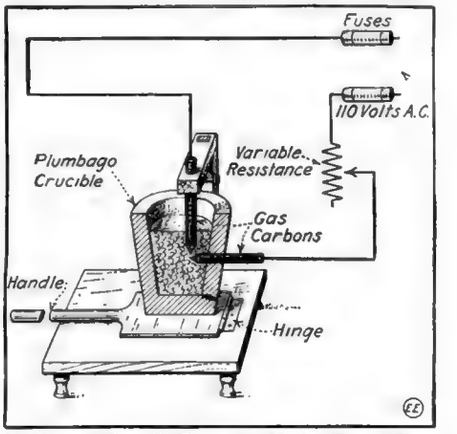
The following stain is excellently adapted to the finishing of wireless and electrical cabinets and instruments, and for various other wooden articles which is desired to have a uniform coloring or finish.

Prepare a solution of 6 ounces of a solution of potassium permanganate, and 6 ounces of sulfate of magnesia in 2 quarts of hot water. The solution is applied with a brush and the application should be repeated. In contact with wood the potassium permanganate decomposes, and a lasting walnut color results. If small pieces of wood are to be thus stained, a very dilute bath is prepared according to the above description, then the wooden pieces are immersed and left in the solution for from 1 to 5 minutes, according to whether a lighter or darker color is desired.

Contributed by ALBERT W. WILSDON.

ELECTRIC FURNACE MADE FROM PLUMBAGO CRUCIBLE.

An interesting and practical electrical furnace can be made of a plumbago crucible (used by jewelers) and two gas carbons. One of the carbons can be inserted in a hole drilled about 1½" from the bottom of the crucible, and the other held in a clamp. But some method must be devised to start the arc—that is, to bring the carbons together and draw them apart. A simple way is to place the crucible on a long board, to be used as a lever, fastened to the base by a hinge of leather. An interesting experiment can be performed by filling the crucible with ground glass up to the lower carbon rod. An arc may be started between the two gas carbons, and this will heat the glass to redness. An arc will then be formed with the carbon rod and the hot glass as electrodes.



A Simple "Arc" Furnace Made From Two Carbon Rods and a Plumbago Crucible.

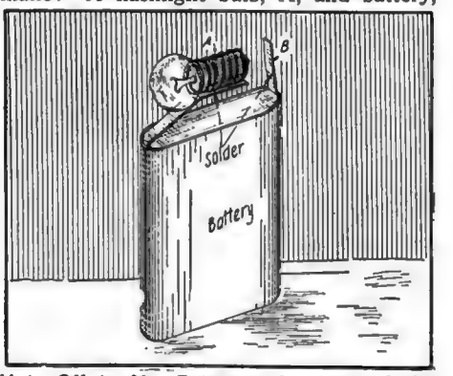
The eyes should always be shielded from the intense light of the arc by dark glasses.

Contributed by TOM RIEBE.

THIRD PRIZE, $1.00

THE SIMPLEST FLASHLIGHT.

Here's the simplest flashlight one can make: A flashlight bulb, A, and battery,

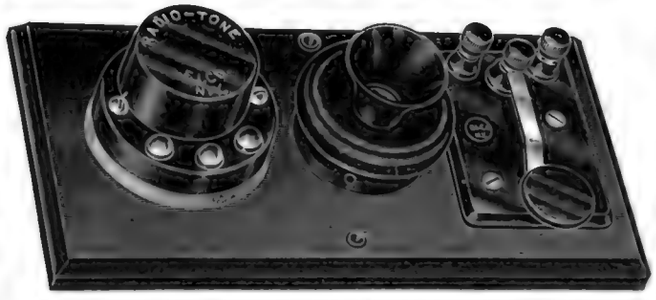


Hats Off to Mr. Peterson—Inventor of the "Simplest" Electric Flashlight. Can You Beat It?

and in some cases a strip of brass, B, soldered to the small battery terminal if it is not long enough. The lamp bulb is carefully soldered to the longer terminal strip. The lamp is lighted by holding battery in hand and pressing with thumb on strip B. A reflector (a nickel-plated thimble will do) may be fixt to the bulb if desired.

Contributed by ERWIN PETERSON.

"ELECTRO"



AMATEURS! ATTENTION!!

Now that we are for the time being, deprived of using our Radio outfits, it behooves us to become proficient in learning the Wireless Codes. Operators who know the Code are, and will be, in ever rising demand. The army and navy need thousands of operators right now. **Can you qualify?** Can you send and receive at the required speed, when your country calls you?

The **Radiotone Codegraph** is positively the only instrument made that will send such an unbelievably close imitation of a high pitch Radio Station, that it has baffled experts. The outfit replaces the old-fashioned learner's outfit, consisting of key and sounder. The **Radiotone Codegraph** comprises our famous Radiotone High Frequency Silent Buzzer, a special loud talking receiver with horn, and a key all mounted on a base. Operated on one or two dry cells, the phone will emit the characteristic high pitch sound, which while not harsh, is heard all over the room. With little trouble you can learn the code correctly in 30 days—

AND THAT IS NOT ALL:

Connect two of these outfits together for intercommunication work and you and your friend five or fifteen blocks distant can converse over a NO. 36 WIRE, so fine that no one will see it. Or you can use instead of the wire, a metallic fence and the ground. **Or you can communicate over your 110 lighting line,** using no extra wire, only the ground. Full directions how to do this are furnished with the instrument. **DEALERS:** This is the 20th Century instrument that will sell like WILDFIRE. 600 sold in New York in 10 days. Get our proposition today!

Radiotone Codegraph complete as described, each, **$1.75**
IMMEDIATE SHIPMENTS

No. FX517

Selenium Cells

Everybody has read about the experiments of telephotography (sending photographs over a wire hundreds of miles) made by Professor Korn and others. It is also known that if the problem of tele-vision is ever solved, the selenium cell will play an important role. At present we are the only concern in the United States selling these cells. They are the most sensitive ones made.

Better send for a cell today and try making an electric dog that will follow a lamp, or an electric burglar alarm. It's very instructive and great fun. (See November, 1916, issue **"Electrical Experimenter."**)

No. FX517 Selenium Cell, each **$6.00**
Shipping Wght., 4 oz.
IMMEDIATE SHIPMENTS

BOYS!

Here Are the Stars and Stripes in All Their Glory

Be the first one in your town to wear this patriotic emblem. Think of it: An electrically illuminated boutonnière worn in the lapel hole of your coat.

It illuminates our National Flag in the original colors with a brilliant electric light. Just insert Flag in button-hole of your coat, put flashlight case in vest or coat pocket and every time you press the button, the flag in your button-hole flashes up with a beautiful color effect.

Illuminated flag, cord and plug (to be connected to any 2 cell flashlight), **$.60** (postage 10 cents).
Illuminated flag, flashlight case and battery, cord and plug, complete as per illustration, $1.10 (postage 15c).
DEALERS: Write for our proposition today.
IMMEDIATE SHIPMENTS

"ELECTRO" TESLA COILS

This photograph shows a seven (7) inch spark

Tesla Coil, made by us in our shops for a well-known institution. We build hundreds of special Tesla Coils for schools, universities, for stage purposes, etc. Spark lengths from two inches to fifteen inches and over.

We are known for careful workmanship and correct designng. The Tesla Coil, shown above (7" spark), without condensers or s-ark gap, sells for **$40.00.** ! Send for our quotations for special coils.

THE ELECTRO IMPORTING CO.

Pat
No.8
Feb5
No.9
Oct2
No.9
Feb1
No.9
Mar.
No.90
June
No.9
Dec2
No 9
April
No 9
April
No 1,0
Jan 3
No 1,0
July
No 1,0
April
No 1,2
Jan 1
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NEWS

No. HK 1800

The "Electro" Radiotone

HIGH FREQUENCY SILENT TEST BUZZER

The RADIOTONE is NOT a mere test buzzer, it is infinitely more. Mr. H. Gernsback who designed this instrument labored incessantly to produce an instrument which would imitate the sound of a high power Wireless station as heard in a set of phones. This actually has been achieved in the RADIOTONE. This instrument gives a wonderful high pitched MUSICAL NOTE in the receivers, impossible to obtain with the ordinary test buzzer. The RADIOTONE is built along entirely new lines; it is NOT an ordinary buzzer, reconstructed in some manner. The RADIOTONE has a single fine steel reed vibrating at a remarkably high speed, adjusted to its most efficient frequency at the factory. Hard silver contacts are used to make the instrument last practically forever.

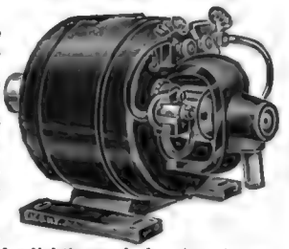
Yes, the RADIOTONE is **SILENT.** In fact, it is so silent that you must place your ear on top of it to hear its beautiful musical note.

You will be astounded at the wonderfully clear, 500 cycle note, sounding sharply in your receivers, when operated on one dry cell. **To learn the codes, there is absolutely nothing like it.** With the radiotone, a key and one dry cell and ANY telephone, a fine learner's set is had. Two or more such sets in series will afford no end of pleasure for intercommunication work. Particularly now that we cannot use our Wireless sets, the **Radiotone** is already in wonderful demand. All the interesting things as described with our **Radiotone Codegraph,** elsewhere on this page, can be performed with the **Radiotone,** a key, a dry cell and a phone.

Radiotone as described.....each **$.90**

IMMEDIATE SHIPMENTS

HERCULES DYNAMO



The Electro Hercules is a dynamo generating 12 Volts, 9 Amperes (100 Watts) and a marvel of electrical or mechanical efficiency and simplicity.

It is especially designed for lighting and charging storage batteries; will run 18 twelve volt lamps simultaneously. Can also be used as a powerful motor developing nearly ⅛ H.P. Machine is shunt wound; size 7 in. high, by 11⅜ in. long and 6½ in. wide. It is the cheapest Dynamo for its output on the market.

No. AGEK 1209. Electric Hercules Dynamo; shipping weight, 40 lbs. Price....**$17.50**

We carry these machines always in stock and can make immediate shipment.

The "Electro" Rheostat-Regulator

(Porcelain Base)

This illustration represents our little current regulator which is used everywhere to regulate battery current. It will prevent the burning out of your battery lamps, or will regulate the speed of your small motors, and scores of other uses.

It makes an excellent automobile lamp dimmer, where it can be used to cut down the glare of the headlights. This little instrument is impossible to get out of order. It is constructed **ENTIRELY OF PORCELAIN,** metal and hard rubber.

The resistance of our Rheostat is 10 ohms, the capacity 3 amperes continually, size is 4 inches in diameter; thickness of **porcelain** base is 13/16 ins.

No. FK5000 Rheostat Regulator. Price **$.60**
Shipping weight, 2 lbs.

IMMEDIATE SHIPMENTS

No. FK 5000

"Electro" Pony Receiver

No. EK 1024

Our Pony receiver is without doubt the best article for the money to-day.

Points of superiority: Hard rubber composition shell beautifully polished. Powerful permanent steel magnet, soft iron core, fibre coil heads, very thin diaphragm, brass posts inside. Hanger can be unscrewed and receiver will then fit our No. AX8077 headbands.

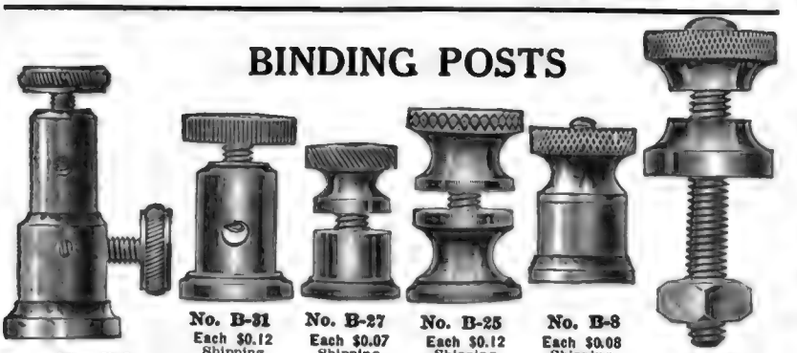
SOME USES.—For all telephone work. Also for making the small testing outfits for repair men in circuit with only one dry cell or flashlight battery. When connected in parallel with your house telephone receiver, you have a double receiver, an invaluable acquisition to those who phone in noisy places or to people hard of hearing. It can also be used for wireless though its low resistance won't permit of such good results as a higher resistance phone.

This receiver is single pole; 2¼x1⅛ inches; wgt. 4 oz.; resistance, 75 ohms. IF TWO OF THESE RECEIVERS ARE USED, IT IS POSSIBLE TO SPEAK AT A DISTANCE OF 150 FEET WITHOUT USING BATTERIES, ONE WIRE BEING SUFFICIENT IF GROUND IS USED. **$0.50**

No. EK1024 Pony Receiver, 75 ohms....

IMMEDIATE SHIPMENTS

BINDING POSTS



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These binding posts are furnished either nickel plated or gold lacquered. They are made of first quality brass; holes are accurately bored, well fitting set screws, and highly polished. Each post is furnished with a ¾ in. machine screw and washer (not shown in illustrations). Engravings are full size.

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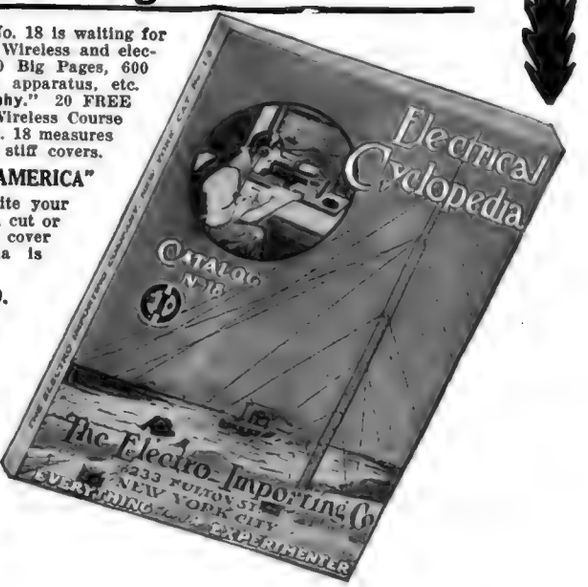


31 FULTON ST., NEW YORK, N.Y.

A NOISELESS "ALARM" CLOCK.

By K. M. Coggeshall.

Have you ever stopt to wonder what your friend in the next room thinks when your discordant alarm clock rings each morning? Have you ever wisht you had

Did You Ever Hear of a "Silent" Alarm Clock?—Well, Here's One. It Awakens You by Flashing a Beam of Light on Your Face. Try It.

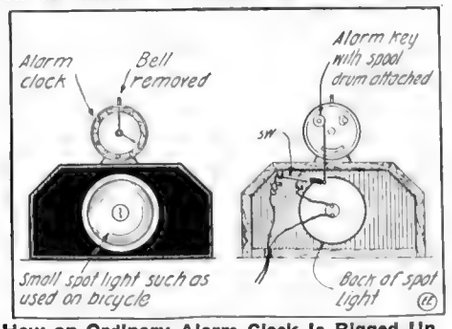
some method of waking yourself without disturbing your neighbors? Perhaps you may arise at five-thirty in the morning while the rest of the household do not find the necessity of opening their eyes until six-thirty. Perhaps some one may be ill and you wish to awake during the night to give him medicine, and yet do not like to disturb anyone else who may be asleep. Again you may be looking forward to a before-dawn start on a fishing expedition but out of respect to others you dislike to resort to the alarm clock to awaken you.

To overcome these objections to the ordinary alarm clock, the following apparatus was designed to awaken one sleeper without disturbing the rest of the household.

A box-like, wooden sub-base was built as shown in the sketch. In its face a round hole was cut and into this was fitted an ordinary bicycle spot light. A single pole, single throw knife switch was screwed to the upper inside surface of the sub-base. The lamp was then connected, thru the switch, to a battery of sufficient capacity to utilize its full candle-power. If the sub-base is made large enough the battery may be enclosed and the entire outfit made compact and portable.

The bell, as well as the striker, was removed from an alarm clock. A thread spool was attached to the alarm winding key to serve as a drum on which the cord to operate the switch was to wind. This switching device was very simple. A strong cord was attached to the handle of the knife switch, brought up thru a hole in the base and attached to the spool on the winding key.

The mechanical operation of this device can well be imagined. The apparatus is set on the mantel or dresser in the bedroom.



How an Ordinary Alarm Clock Is Rigged Up So as to Close the Lamp Circuit of the "Silent Alarm."

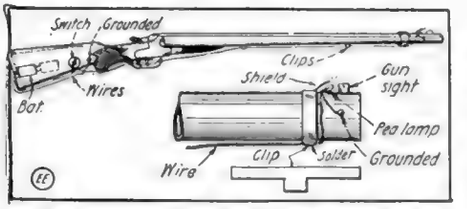
The spot light is then so adjusted that the full power of the light ray will concentrate on the face of the sleeper. The alarm should be wound and adjusted as usual.

When the predetermined hour has arrived, the alarm mechanism operates, turning the drum, thus winding in the cord, which in turn closes the switch and lights the lamp. All this will be accomplished noiselessly. No one can sleep with a bright beam of light suddenly directed onto the face. Furthermore, it is impossible to snatch a few catnaps before getting up with this light in the eyes. It is therefore imperative that the awakened person arise and open the controlling switch—and once out of bed there is little danger of dropping off to sleep again.

ELECTRIC LIGHT FOR GUN SIGHTS AT NIGHT.

As every hunter knows, it is extremely difficult to aim correctly at night, even tho the game can be seen, for the simple reason that the gun sights on the barrel cannot be accurately viewed.

The accompanying illustration shows how a small, frosted, flashlight bulb may be placed just behind the forward sight, with a metallic shield over it, so as not to throw a glare in the gunner's eyes. It is a simple matter to bore a hole in the wooden stock of the gun with an ordinary carpenter's brace and bit, in which to mount a cell or two from a flashlight battery, the size of these individual cells being about 1¾"x7/16" in diameter. Also the cells may be placed in a brass or fibre tube secured under the



A Tiny Electric Light Fixt Just Back of the Forward Sight Proves a Boon to the Hunter at Night.

fore-arm section of the gun frame. A switch, of unobtrusive proportions, will serve to light the lamp bulb when wanted.

H. G.

GOOD INK FORMULAE.

These two formulae obtained thru original experiments, have been found to produce excellent inks. The ingredients are easily obtained and at little expense. Rain water may be used in place of distilled water thus removing the need of having any chemical apparatus. The resulting inks are each of a beautiful color, make a permanent record, flow easily, and do not corrode the pens. The blue ink can be used successfully and safely in the most delicate of fountain pens.

Blue Ink: Dissolve one ounce of soluble prussian blue in one quart of cold distilled (rain) water. Add to this solution, 5 grams of oxalic acid. Then filter the solution thru filter or blotting paper.

Black Ink: Dissolve one ounce of extract of logwood in one quart of boiling water. When cold, add one-fourth ounce of potassium bichromate and one gram of sodium carbonate. The addition of one-fourth ounce of prussian blue improves the solution. This ink will cost about 5 cents.

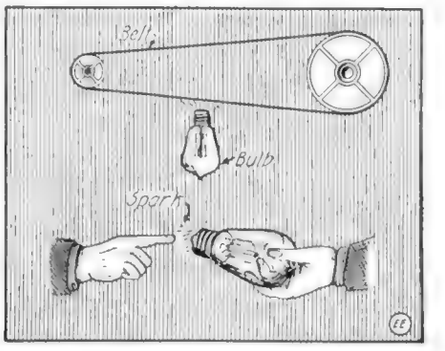
Contributed by

CLARENCE S. LEVINE.

STATIC EXPERIMENTS WITH LAMP BULB.

Materials needed—1 or more burned-out electric light bulbs.

Experiment—Take the bulb and hold it near a rapidly moving belt, connected with machinery which is not grounded. Hold the brass end of the bulb close to the



Hold an Incandescent Lamp Bulb Near a Rapidly Moving Belt—Usually Sufficient Static Electricity Will Pass to Charge the Lamp as a Condenser. It Will Give Powerful Shocks.

belt and sparks will usually jump from the belt to the brass cap.

Charge in this manner for about five minutes, then take it away. Offer it to someone, holding the bulb by the glass end always. When the person goes to touch the brass end a nice hot spark will jump to him, giving a considerable shock.

Contributed by R. G. DEVANEY.

KNICK-KNACKS FOR "RADIO-BUGS."

By placing one of the E. I. Co.'s loading coils against the end of a small loose coupler, I have been able to catch stations, using up to 6,000 meters, this being done without additional inductance in the secondary, built for only 800 meters.

Most loose couplers have the primary tube placed in grooves cut in the heads and by turning it, a new surface is obtained for the slider. Clean the path of the slider occasionally with a rubber pencil or ink eraser.

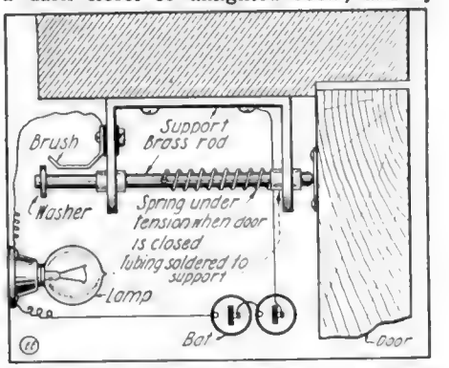
Use *Solderall* on the next loose coupler you build and you will use no other.

Contributed by ASA S. KELLER.

AUTOMATIC LIGHT SWITCH FOR CLOSETS.

Herewith is a drawing of a little device I made from scrap materials and which has proved very efficient.

It is intended to automatically close an electrical circuit on opening the door of a dark closet or unlighted room, and by



A Reliable Automatic Switch for Closet Light. When Door Opens the Switch Rod Is Moved Forward by the Spiral Spring as Becomes Evident, and Vice-versa.

means of a small battery and lamp illuminate the interior.

As the illustration shows, the materials and construction are exceedingly simple.

Contributed by H. W. WALTER.

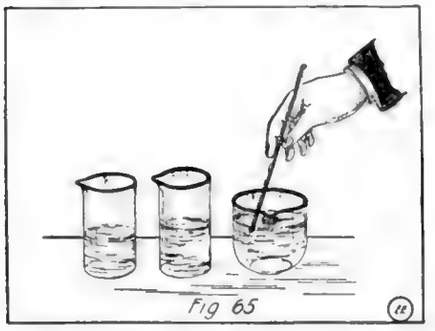
Experimental Chemistry

By ALBERT W. WILSDON
Thirteenth Lesson

ACIDS, BASES AND SALTS.

(*Continued*)

As stated in the previous installment, the basicity of acids are determined by the number of hydrogen atoms [replaceable by a metal] in its molecule. Thus: Mono-basic acids contain one hydrogen atom, as Hydrochloric acid [HCl], from which only one replacement is possible. Di-basic acids contain two hydrogen atoms, as, Sulfuric acid [H_2SO_4], from which two replacements are possible. Tri-basic acids contain three hydrogen atoms, as Phosphoric acid [H_3PO_4], from which three replacements are possible. Tetra-basic acids contain four hydrogen atoms, as, Normal Silicic acid [H_4SiO_4]. [Note: Normal Silicic acid readily parts with half of its water, leaving H_2SiO_3, also called Silicic Acid], from which four replacements are possible. Penta-basic acids contain five hydrogen atoms, as Periodic acid [H_5IO_6], from which five replacements are possible.



It Is Always Best to Stir Solutions with a Glass Rod. Have a Clean Vessel for Each Acid if You Would Achieve Satisfactory Results.

The higher the basicity of the acid the greater the variety of salts it can yield.

If we take the base Potassium Hydroxid to illustrate the replacement of the hydrogen of the acids, we find that Nitric acid or Hydrochloric acid can form but one salt with Potassium Hydroxid, the reactions being:—

$$\underset{\text{Potassium Hydroxid}}{KOH} + \underset{\text{Nitric Acid}}{HNO_3} = \underset{\text{Potassium Nitrat}}{KNO_3} + \underset{\text{Water}}{H_2O}$$

and

$$\underset{\text{Potassium Hydroxid}}{KOH} + \underset{\text{Hydrochloric Acid}}{HCl} = \underset{\text{Potassium Chlorid}}{KCl} + \underset{\text{Water}}{H_2O}$$

Other acids have the power to form two or more salts with the same base.

If only half the quantity of base that is required to neutralize the acid is added, half the acid remains unchanged, and on evaporating the solution, the excess acid will pass off. If only half the quantity of acid that is required to neutralize the base is added, half the base will remain unchanged. Sulfuric acid [H_2SO_4] has been found to have the power to form two salts with Potassium Hydroxid [KOH], in one of which there is twice the amount of the metal as in the other. The reactions being:

$$\underset{\text{Potassium Hydroxid}}{KOH} + \underset{\text{Sulfuric Acid}}{H_2SO_4} = \underset{\text{Potassium [acid] Sulfate}}{KHSO_4} + \underset{\text{Water}}{H_2O}$$

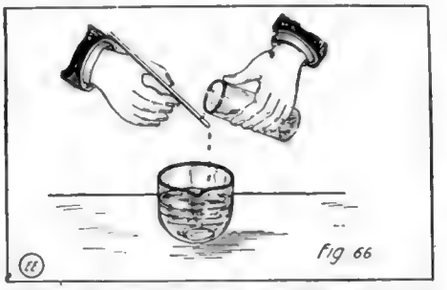
and again:—

$$\underset{\text{Potassium Hydroxid}}{2KOH} + \underset{\text{Sulfuric Acid}}{H_2SO_4} = \underset{\text{Potassium Sulfate}}{K_2SO_4} + \underset{\text{Water}}{H_2O}$$

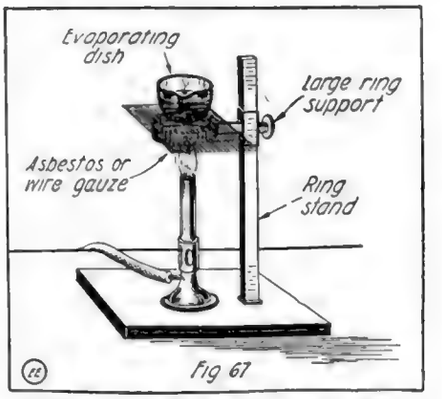
If to a certain quantity of Sulfuric acid only half the quantity of Potassium Hydroxid that is required to neutralize it is added, the first reaction takes place; but if twice as much Potassium Hydroxid is used, the second takes place. An acid of this kind can, further, form one salt with two bases, in which one metal is substituted for one of the hydrogen atoms of the acid and a second metal for the other.

As aforementioned, in the molecule of Hydrochloric acid [HCl] as in Nitric acid [HNO_3], there is but one atom of hydrogen. If, therefore, the act of neutralization takes place in each molecule it is complete, and the salt is known as a *neutral* or *normal salt*. In Sulfuric acid [H_2SO_4] there are two atoms of hydrogen in each molecule, and either one or both of these atoms may be replaced. If only one is replaced a salt having the general formula, $MHSO_4$, is obtained. This is still an acid, while it is also partly a salt. This is known as an *Acid Salt*.

It may be difficult for some readers to associate the names Monobasic, Dibasic, Tribasic, Tetrabasic, etc., with the basicity of the acids, but as these names represent the number of hydrogen atoms in the molecule, it may be well to memorize the following:



Method of Pouring Small Quantities of Acid onto a Glass Rod so That They Drop Into a Beaker or Other Dish Easily.



Correct Manner In Which to Place "Evaporating Dish," Wire Gauze and Bunsen Burner.

The	prefix	*Mono—*	means	one
"	"	*Di—*	"	two
"	"	*Tri—*	"	three
"	"	*Tetra—*	"	four
"	"	*Penta—*	"	five

Thus, when speaking on monobasic acids, by remembering that mono— means one, and when associated with the basicity of an acid, mono— meaning one, and the basicity being the number of hydrogen atoms, we can thus see that monobasic means one hydrogen atom.

EXPERIMENT NO. 54—

Have two small-lipt beakers, or two test tubes, one of which will contain 10 cc. of a solution of Sodium Hydroxid [NaOH] and the other an equal quantity of Hydrochloric acid [HCl]. Pour 5 cc. of the Sodium Hydroxid solution in an evaporating dish, and immerse in it a piece of blue litmus paper, allowing it to remain in the solution. Pour small quantities of Hydrochloric acid from the beaker onto a glass rod, allowing it to drop into the evaporating dish, in the manner shown by Fig. 66, stirring the mixture.

It will be noticed that the litmus paper will probably turn red, owing to the fact that the solution has too much acid contained in it. If such is the case, add a little more Sodium Hydroxid, by allowing to drop from a stirring rod in the same manner as described for the acid. If too much of the Hydroxid is added the litmus paper might again turn to a blue color, and if this happens, add a little more of the acid, drop by drop, till the liquid becomes neutral to the litmus paper. It may be necessary to keep adding either the Acid or the Hydroxid. Introduce another piece of red litmus when you think the solution is neutral, and if it is unaffected, immerse another piece of blue litmus paper in it, and then if the solution does not affect either the red or blue paper it is neutral. If the solution is not clear after it has been neutralized, filter it, and throw away all but about 15 cc. of it.

Place the 15 cc. of the solution obtained into an evaporating dish, and place on either a piece of fine meshed iron gauze or a piece of asbestos pad, as shown in Fig. 67. Apply a light to the Bunsen burner under the evaporating dish, and allow the liquid to evaporate [boil] till a white solid is formed, or in other words till all the water has been driven from the original solution.

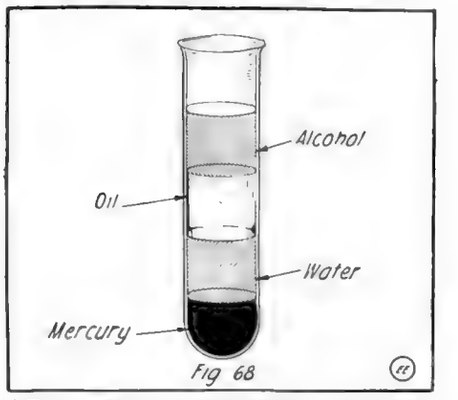
The equation of the reaction which took place between the Sodium Hydroxid and the Hydrochloric acid when neutralized was:—

$$\underset{\text{Sodium Hydroxid}}{NaOH} + \underset{\text{Hydrochloric Acid}}{HCl} = \underset{\text{Sodium Chlorid}}{NaCl} + \underset{\text{Water}}{H_2O}$$

We perceive from this equation, that the hydrochloric acid no longer is contained in the solution, and that the Sodium [Na] of the base exchanged, or replaced the hydrogen of the acid, forming a salt and water.

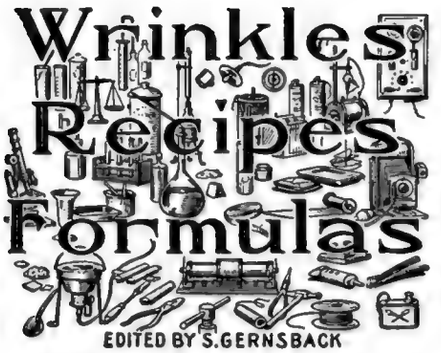
EXPERIMENT NO. 55—

In the same manner as described in the preceding experiment, prepare a solution of both Potassium Hydroxid and Hydro-



If Two or More Liquids Which Have Different Densities and Will Not Mix Are Poured Into a Jar, They Will Come to Rest In the Order of Their Densities, with the Surfaces of Each Separating Them Horizontally. Mercury, Water, Oil and Alcohol, When Poured In a Test Tube, Will Come to Rest In the Order Named.

(*Continued on page* 127)



Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FREEZING MIXTURES.

When ice or snow are not to be had and for those of us who do not have an up-to-date laboratory that is provided with agencies of cooling power, I am sure the following mixtures will prove most convenient.

1. Nitrat of ammonia, carbonat of soda and water, equal parts by weight; the thermometer sinks 57°.

2. Phosfate of soda, 9 parts; nitrat of ammonia, 6 parts; dilute nitric acid (acid 1 part, water 2 parts), 4 parts. Reduces the temperature from 50° to 21°.

3. Sal-ammoniac, 5 parts; nitrat of potash, 5 parts; sulfate of soda, 8 parts; water, 16 parts. Reduces the temperature 46° or from 70° to 24°. This latter is very cheap and easily procured.

If you have ice and wish to reduce the temperature still further, use the following:

1. Finely pounded ice, 2 parts; salt, 1 part. This is a very common recipe.

2. Finely pounded ice, 2 parts; crystallized chlorid of calcium, 3 parts.

3. Finely pounded ice, 7 parts; dilute nitric acid, 4 parts. This reduces the temperature from 32° to 30°. The temperatures given are Fahrenheit. The materials should be kept as cool as possible.

Contributed by MINARD ROTE.

SOLUTION FOR MAKING WORK TABLE IMPERVIOUS TO ACID AND ALKALI SOLUTIONS.

Doubtless, many experimenters, especially those working with the various chemical reagents, desire some coating for the work table that is impervious to both acid and alkali solutions. The writer has used the following method in his laboratory with decided success, and heartily recommends it to those who desire a similar formula.

Two solutions are to be made:

Solution 1. Iron sulfate, 4 parts; copper sulfate, 4 parts; potassium permanganate, 8 parts; water, 100 parts.

Solution 2. Aniline, 12 parts; hydrochloric acid, 18 parts; water, 100 parts, or aniline hydrochlorat, 15 parts; water, 100 parts.

Apply two coats of solution No. 1, while hot, applying the second coat as soon as the first has dried. After solution No. 1 has dried, the excess of solution which has dried upon the surface of the wood is thoroly rubbed off before the application of solution No. 2.

Next, two coats of solution No. 2 are applied, and the wood permitted to dry thoroly. The black color does not appear at once, but requires a few hours before turning to a rich ebony-black color. Later a coat of raw linseed oil is to be applied with a cloth.

The tables are cleaned very easily by washing with water or suds after any work is finished, and the application of another coat of oil puts them in excellent order for another experiment.

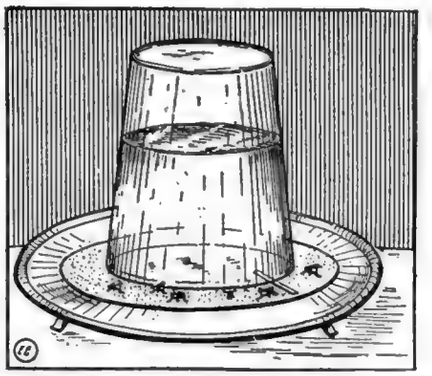
Contributed by
ALBERT W. WILSDON.

RECIPES FOR KILLING FLIES.

The United States Government makes the following suggestion for the destruction of house flies: Formaldehyde and sodium salicylate are the two best fly poisons. Both are superior to arsenic. They have their advantages for household use. They are not a poison to children; they are convenient to handle; their dilutions are simple, and they attract the flies.

Preparation of Solutions:—A formaldehyde solution of approximately the correct strength may be made by adding 3 teaspoonfuls of the concentrated formaldehyde solution, commercially known as formalin, to a pint of water. Similarly, the proper concentration of sodium salicylate may be obtained by dissolving 3 teaspoonfuls of the pure chemical (a powder) to a pint of water.

A container such as shown below has been found convenient for automatically keeping the solution always available for flies to drink. An ordinary, thin-walled drinking glass is filled or partially filled with the solution. A saucer, or small plate, in which is placed a piece of *white* blotting paper cut the size of the dish, is put bottom up over the glass. The whole is then quickly inverted, a match placed under the edge of the glass, and the container is



Now That the "Fly Season" Is With Us, the Non-Poisonous (to Humans) Wet Blotter Fly Annihilator Shown, Which Is Recommended by the U. S. Government, Should Prove Particularly Valuable.

ready for use. As the solution dries out of the saucer the liquid seal at the edge of the glass is broken and more liquid flows into the lower receptacle. Thus the paper is always kept moist.

Other Simple Preventives:—Any odor pleasing to man is offensive to the fly and *vice versa*, and will drive them away.

Take five cents' worth of oil of lavender, mix it with the same quantity of water, put it in a common glass atomizer and spray it around the rooms where flies are. In the dining-room spray it lavishly *even on the table linen*. The odor is very disagreeable to flies but refreshing to most people.

Geranium, mignonette, heliotrope and white clover are *offensive* to flies. They especially *dislike* the odor of honeysuckle and hop blossoms.

According to a French scientist, flies have intense hatred for the color *blue*. *Rooms decorated in blue will help to keep out the flies.*

Mix together one tablespoonful of cream, one of ground black pepper and one of brown sugar. This mixture is poisonous to flies. Put in a saucer, darken the room except one window and in that set the saucer.

To clear the house of flies, burn pyrethrum powder. This stupefies the flies, but they must be SWEPT UP and BURNED.

Receipes for Stables, Barns and Out-of-doors:—Borax is especially valuable around farms and out-of-doors. One pound of borax to twelve bushels of manure will be found desirable as a poison without injuring its manurial qualities on farm stock. Scatter the borax over the manure and sprinkle with water.

Lye, chlorid of lime, or copperas (sulfate of iron) dissolved in water, crude carbolic acid, or any kind of disinfectant may be used in vaults.

HEKTOGRAPHS.

What are they, do you ask? The Century Dictionary defines it as follows: "A copying process in which the writing or drawing to be copied is made on smooth paper in aniline ink, and is then prest upon a slab coated with gelatin, to which a part of the ink is thus transferred, and from which a number of duplicate impressions can be made; also, the special appliances, collectively, by means of which this is done." The chance, however, is that you do not want any definition, but might like some directions for simplifying the process, which some teachers and students who want a number of copies of text or drawing, are using successfully. Agreeable to this contingency, we have:

Receipt No. 1.—Soak an ounce of fish glue in cold water. Drain off the water; put the softened glue into a double boiler and melt it, but *do not* bring it to a boil. Obtain six ounces of glycerin, warm it and add it to the melted glue. Add a few drops of carbolic acid. Mix thoroly and pour into your pan. A caramel pan is best.

Receipt No. 2.—Add 3 ounces of water to 1½ ounces of white glue. Heat in a double boiler until glue is melted. Then add six ounces glycerin and pour into pan. If too hard, add glycerin. If too soft, add glue.

Receipt No. 3.—Dissolve 4 ounces of gelatin in one pint of cold water; then add one pint of glycerin. Pour into a double boiler, and when it comes to a boil pour into your pan.

If bubbles appear on the surface, gently draw an edge of a sheet of writing paper over the surface before it cools. This will remove them.

General directions for use.—Use nothing but unglazed paper, which can be purchased at any store where typewriter paper is sold. In ordering, be sure to state that you wish to use it for hektography.

Use *hektograph ink* and a coarse stub pen. See that every stroke of the pen leaves a metallic luster when dry, else the work will not *take*.

When the ink is dry, lay the face of the sheet which you have written or drawn, down on the hektograph; press gently over the whole surface with the hand or soft cloth. After from two to five minutes (according to how many copies are desired) gently peel the paper off.

From the impression thus made, reproduce all the copies desired, laying one sheet on the hektograph at a time.

Hektograph ink all prepared may be bought, or your druggist will put it up for you. The following is the receipt:

Ink—Dissolve one dram of purple aniline in one ounce of water.

The hektograph solves the supplementary reading question. Each teacher, or any one who desires a number of copies of any text or drawing, can thus prepare as many as needed, at a very small cost.

Contributed by F. H. SWEET.

WITH THE AMATEURS

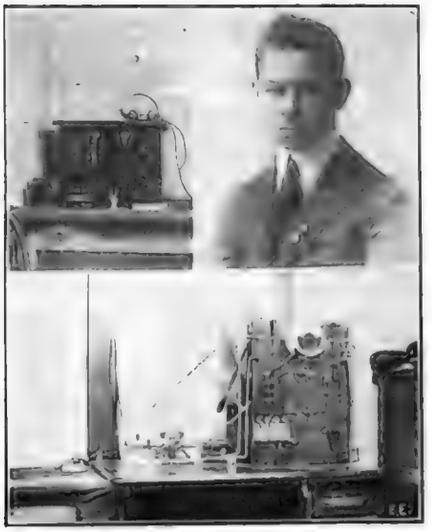
Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month **$3.00** prize for the best photo. Make your description brief and use only one side of the sheet. Address the Editor, "With the Amateurs" Dept.

AMATEUR RADIO STATION CONTEST

Monthly Prize, $3.00.
This month's prize-winner.

CEDRIC E. HART'S EXCELLENT RADIO OUTFIT.

The switch panel and cabinet, etc., shown in the accompanying photo have all been



Cedric E. Hart's Radio Station at Salt Lake City, Utah, with Which He Obtained Highly Efficient Results.

designed and built by myself, and with this cabinet I have no difficulty in receiving all of the coast stations and the amateurs within a fair distance of here. I also hear Guam, Honolulu, Alaska, Panama, etc., quite regularly. I have a license and my call is 6SL. My receiving set comprises the following: Navy 'phones, Blitzen tuner, Blitzen variable, Clapp-Eastham tubular fixt condenser, Turney variable condenser, and an Audion cabinet.

My transmitting outfit comprises a 1K.W. Thordarson transformer, K.B. preventer, commercial key, home-made condenser, Halcun rotary spark gap, home-made Telefunken type oscillation transformer and a Blitzen hot-wire meter. The switches on the panel control the transformer, power, meter, condenser and inductance.

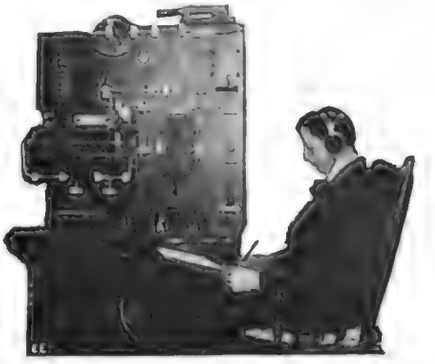
This set, so far, has proven very efficient and, being as the panel has not been completed two weeks yet, I think that Evanston, Wyo., is a pretty good distance to transmit for the short time I have had it. Here's wishing the EXPERIMENTER prosperity in its chosen path.

CEDRIC E. HART.
Salt Lake City, Utah.

H. L. SCOTT TO RENEW HIS RADIO ACTIVITIES.

Just recently I bought a copy of THE ELECTRICAL EXPERIMENTER, the January number, and on reading it thru it has brought back pleasant memories of the days when I operated my station. In fact it has thrilled me so much that I am going to renew my operations with the old vigor. (*Not until after the War—Ed.*)

It was when I lived at 158 Hamilton Street, East Providence, R.I., in 1909 and 1910, that I had my best outfit. About that



Herbert L. Scott and His Radio Outfit, Which Has Done Good Work.

time I believe I bought a detector from the Electro Importing Co.

I am sending you a photo of my apparatus I used in 1910, which I still have in storage. I hope you will find space in the columns of your magazine to reproduce this photo. For sending I used a three inch spark coil, run by six V. 60 A.H. storage batteries. The coil may be seen behind the loose coupler on the table; over the coil on the board is a plate glass condenser; above that is the spark gap and then the helix; to the right is an anchor gap. The sending key may be seen on the extreme right of the table; the contact points are two dimes.

For receiving I had a loose coupler of my own make, a Murdock tuning coil and a detector stand in which I used silicon, together with a pair of 3,000 ohm receivers, potentiometer, fixt condenser and Massie sealed-point electrolytic detector with double pole switch to throw in either system. I have heard Key West with this station.

HERBERT L. SCOTT.
Blackstone, Mass.

(*All radio men should read the notice in "Radio Dept." and on opposite page—Ed.*)

THE MONTANA WIRELESS STATION OF HOWARD PASCOE.

I offer herewith a photograph of "The Montana Wireless Station" which consists of 1 K.W. Packard transformer, run on (110 volts A.C.) and a stationary spark gap.

The receiving set consists of a loose coupler designed to receive up to 20,000 meters and a loading coil for 4,000 meters.

One (type D) receiving set of Marconi Wireless Telegraph Co. make which has a range of 2,000 to 4,000 meters or more. One pair of E. I. Co. Republic receivers, Standard wave meter, silicon and Audion detectors (Type R J 9).

With this receiving set I am able to hear all the coast stations such as NPE, NPC, and the amateurs 7ZC, 7JN and many others.

I have a little sub-station up in the mountains, 6,355 feet above sea-level. All my wiring is run in conduit. On account of the small space, the station had to be photographed twice.

I read THE ELECTRICAL EXPERIMENTER. It is a fine magazine for the "Wireless Bugs." I will be glad to correspond or exchange photos of my station with other amateurs.

HOWARD PASCOE.
Butte, Montana (1129 East Galena)

Uncle Sam May Find the Amateur Radio Station of Howard Pascoe, at Butte, Montana, of Valuable Assistance.

ATTENTION!!!

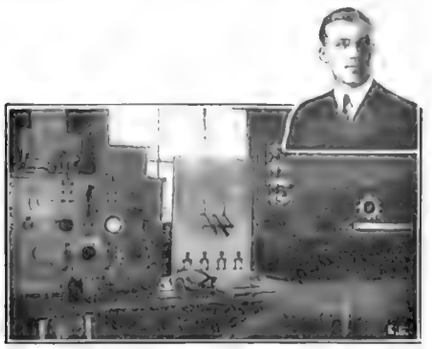
Has your station photo appeared in "The Electrical Experimenter"? Why not purchase the electrotype and have some "real" stationery printed with your station picture on it? All of the "regular radio-bugs" are doing it.

"NO MORE 'E.E.'"

says the newsdealer. "All sold out!" Did he tell YOU so last time? MORAL: Ask him to order a copy for you every month. *Costs you nothing to do so.* The tremendous cost of paper does not allow excess printing, so we furnish dealers only with a sufficient amount of copies to supply their *regular* customers. If you are one, be sure to tell your newsdealer so, and give him your name and address, so he'll notify you by postal if you forget to call.

A PROGRESSIVE CHICAGO RADIO EXPERIMENTER.

My sending set included a ¼ K.W. Blitzen transmitter with rotary spark gap, operated on 110 volts A.C. with a lamp bank in series with gap motor. Receiving set is result of reading *Modern Electrics* and THE ELECTRICAL EXPERIMENTER for over 2½ years and is home-made



One of the Honor Sets Among Chicago Radio Amateurs Was that of Mr. A. R. Gates. Mr. Gates Is One of the "Old Guard Boys," Having Been a Reader of "Modern Electrics."

The receiving transformer is designed for 3,000 meters with two variable condensers: one across secondary and one shunted across 'phones. I have two crystal detectors, Ferron and galena, operated with a three point switch. Also a three element vacuum detector for long range work. The two D.P.D.T. switches on each side of Audion make a complete switch-over from crystal to Audion apparatus. Also to amplify weak signals there is a Multi-Audi-Fone and 2,000 'phones. Station call 9NV.

Chicago, Ill. ARTHUR R. GATES.

AMATEUR HEARS SPY RADIO CODE.

Federal authorities hope to locate the sender of aerial instructions to German spies thru the disobedience recently of Malcolm Ronberg, who has (or had) an amateur radio plant at his home, 6220 University Avenue, Chicago, Ill.

Ronberg failed to obey the government mandate to dismantle radio stations. He decided to "listen in" before complying.

There was no sound for several minutes, then a peculiar unfamiliar call, repeated over and over again. Then there followed an even stranger grouping of letters, a code message.

Ronberg hurried to the federal building, confest he had been listening and turned over the message. It was sent to federal operators at Great Lakes station. They, too, failed to decipher it. But the fact that Ronberg received it in his small amateur station has helped the searchers to trace it.

Ronberg was thanked, instructed to dismantle his plant by midnight or go to jail, and a squad of detectives was hurried out under orders of John C. Dillon, chief radio inspector of Chicago.

Young chickens treated with electricity by a London experimenter grow more rapidly than those raised without treatment.

DE FOREST GIVES $5,000 TO AMERICAN DEFENSE SOCIETY.

Dr. Lee de Forest, the wireless inventor, has offered the American Defense Society $5,000 as the nucleus of a preparedness fund.

A RADIO ECHO FROM LARCHMONT MANOR, N.Y.

Herewith is a photo of my radio station. The sending set is composed of a 1 inch Bull-Dog spark coil, a sending condenser, spark gap, key and transformer. In my receiving set there are three loading coils, two fixt condensers, a double slide loose-coupler, a silicon detector and a de Forest Audion. I have two 1,500 ohm 'phones and one 500 ohm 'phone.

Clarence de Witt Rogers, Jr., a Rising Radio Student, of Larchmont Manor, N. Y.

CLARENCE de WITT ROGERS, JR.
Larchmont Manor, N.Y.

Amateur News

Fort Wayne Radio Association of Indiana.

The Fort Wayne Radio Association of Indiana began the New Year with the installation of the following new officers: G. Carter, President; R. Parvin, Vice-president; D. W. May, Secretary and F. Hall, Treasurer.

We have had some very successful meetings during the winter months. Our best and most-lookt for speeches are given by Mr. Carter, who, besides giving good talks, has formulas worked out, which enables us to see if we are getting the most out of our transmitters.

In an effort to lessen interference, we have a "QRM Committee" to report at our meetings every two weeks.

Several of our members have some fine long-distance work to their credit. They are 9 P C, 9 W F, 9 V Y, 9 T A, 9 K G and 9 U H.

We will be glad to correspond with other clubs so as to exchange ideas. Address communications to D. W. May (9 U H), 3021 Hoagland Avenue, Fort Wayne, Ind.

Alpena, Mich., Has a Radio Club.

The Alpena Radio Club of Alpena, Mich., has been formed for the advancement of wireless telegraphy. Meetings are held every Thursday evening at the home of the President, 516 State Street. The officers are: President, W. A. Potter; Vice-president, Hugo Sorenson; Secretary and Treasurer, P. B. Alger; and Consulting Engineer, Mr. J. Mulavey. All communications should be addrest to the Secretary, P. B. Alger, 119 State Street, Alpena, Michigan.

Allentown, Pa., Radio Men Reorganize.

The Inter-City Radio Association of Allentown, Pa., organized October 28, 1915, recently reorganized under a new name to be known henceforth as The Y. M. C. A. Radio Association of Allentown.

The art of field signaling and code receiving are now being taught to the members by the Chief Operator, Harvey Zinger. The following are the new officers of the Association: D. H. Goodling, President; Stanton Nadig, Vice-president; Blair Cunningham, Secretary; Arthur Breisch, Treasurer; Harvey Zinzer, Chief Operator. Correspondence with similar organizations will be appreciated. Address all communications to D. H. Goodling, 330 N. Madison Street, Allentown, Pa.

Radio Activities in Kansas City, Kansas.

The Kaw Valley Radio Association has been formed by the amateurs of this city. The club to date has seventeen members with officers as follows: Ralph Rehm, President; Parker Wiggin, Vice-president; Harlow Eppert, Secretary; Joe Harlan, Treasurer.

The club is progressing rapidly and is certain to obtain more members in the near future. As yet we have no set but expect to obtain one soon. Regular meetings are held every Thursday night at 7:30. All communications should be sent to Harlow Eppert, 841 State Avenue, Kansas City, Kansas.

Y. M. C. A. Wireless of Salesburg, Ill., Sends Basketball Scores.

The wireless club of the Y. M. C. A. recently sent out the scores of the basketball tournament. These scores were sent out three times a day, at the close of each session, 12:00 o'clock noon, 6:00 o'clock after the afternoon session and at 10:00 o'clock after the night session. The towns which were connected with Thursday night were Rock Island, Peoria, Springfield, Cambridge, Genesee and Monmouth.

Roy S. Landon had charge of this work, and under his supervision the boys are showing an unusual amount of interest. Recently the boys received and sent messages to the University of Iowa station.

ALL RADIO AMATEURS ATTENTION!

As all of you know the United States is now in a state of war with Germany, and as true-blood American citizens, we are, each and every one of us, duty bound to obey the mandates of the U. S. Government officials. The Navy Department has been delegated by our President to close all amateur or experimental radio stations, no matter whether equipt for transmitting or receiving, licensed or unlicensed, and therefore we shall all have to abide by this decree, whether we like it or not.

Therefore, beginning with the next issue of "THE ELECTRICAL EXPERIMENTER," we will endeavor to feature the Electrical Laboratories in preference to any radio stations in the awarding of the monthly prize of $3.00 in this department. Now is the time to get busy and freshen up your electrical apparatus, and incidentally improve your understanding of electrical matters, which perhaps you have unwittingly slighted to a large degree in your pursuit of radio-telegraphy. Let her go, boys!

Worcester Tech. Wireless Club is Busy.

The Wireless Club of Worcester Tech., elected Warren B. Burgess, '16, of Hyde Park, chief operator in charge of the maintenance of the Tech. station. Twelve new members were voted in and plans were discust for a series of talks to be given by Instructor Carleton D. Haigis of the physics department on the theory of electric waves and other subjects interesting to wireless students. The president was empowered to appoint a committee to draw up plans of a new antenna to be erected this year.

Hoboken, N. J., Wireless Amateurs Secure Clubrooms.

The Hudson City Radio Association has secured rooms, at 541 Central Avenue, Jersey City, where they have erected a large aerial and a sensitive receiving outfit. Code practise is given every night to those who desire it.

Election of permanent officers was held with the following results: President, Joseph F. Grece; Vice-president, William Biedenkapp; Financial Secretary, Frank V. Bremer; Recording Secretary, Clarence Maves; treasurer, William S. Davidson.

All amateurs in Hudson County are invited to join the association. Address Clarence Maves, Secretary, 90 Ferry Street, Jersey City, N.J., for an application blank.

Waterbury Radio Club of Waterbury, Conn.

The Waterbury Radio Club was formally organized recently by 15 local young men who are interested in wireless telegraphy. King Sam, the Chinese young man who is probably the only Chinese wireless operator in New England, took the initiative in banding the local operators together and the meeting was held in the wireless room at the Boys' Club. E. C. Glavin, an inventor and a pioneer in wireless telegraphy study, attended the meeting and was named as honorary chairman. The other officers are Robert W. Culbert, Jr., Chairman; Clinton A. Fitch (operator of the Boys' Club wireless set), Secretary and Treasurer. The membership of the club is 15 just now and it is planned to increase it to 25 later.

The publicity secretary for the club is King Sam. He stated that it is the purpose of the organization "to further advance and foster the art of wireless telegraphy in this city."

EXPERIMENTAL CHEMISTRY.

(*Continued from page* 123)

chloric acid, and proceed to neutralize them in the same manner. After they are neutralized, and after applying the litmus tests, place in a clean evaporating dish and evaporate the solution to dryness. The equation for this reaction is practically the same except that Potassium is substituted for the Sodium, as:—

$$\underset{\text{Potassium Hydroxid}}{KOH} + \underset{\text{Hydrochloric Acid}}{HCl} = \underset{\text{Potassium Chlorid}}{KCl} + \underset{\text{Water}}{H_2O}$$

TABLE OF VALENCE.

TABLE NO. 1.

Metals and Positive Radicals.				Non-Metal and Negative Radicals.			
Monad.	Dyad.	Triad.	Tetrad.	Monad.	Dyad.	Triad.	Tetrad.
H	Mg	As	Pt	F	O	N	C
Na	Ca	Sb	Sn	Cl	S	P	Si
K	Sr	Bi		Br	SO_3	B	SiO_4
Ag	Ba	An		I	SO_4	PO_3	
Hg	Pb	Fe		NO_2	CO_3	PO_4	
NH_4	Cu	Cr		NO_3	C_2O_4	AsO_3	
CH_3	Cd	Al		ClO	$C_2H_4O_6$	AsO_4	
C_2H_5	Zn			ClO_2			
	Co			ClO_3			
	Ni			ClO_4			
	Hg			BrO_3			
	Sr			IO_3			
	Fe			$C_2H_3O_2$			

As we have been constantly referring to metals, non-metals, positive radicals and negative radicals, the above table is given now, before the study of valence is taken up, so that readers may refer to it when metallic and non-metallic elements are mentioned.

EXPERIMENT NO. 56—

Dilute 1 part of Sulfuric acid with three or four parts of water, and place in a small-lipt beaker or test tube as in the preceding experiments, and neutralize. When neutral, filter, and place in an evaporating dish and evaporate to dryness. Either one of the following equations will take place:—

$$\underset{\text{Potassium Hydroxid}}{KOH} + \underset{\text{Sulfuric Acid}}{H_2SO_4} = \underset{\text{Potassium [Acid] Sulfate}}{KHSO_4} + \underset{\text{Water}}{H_2O}$$

or

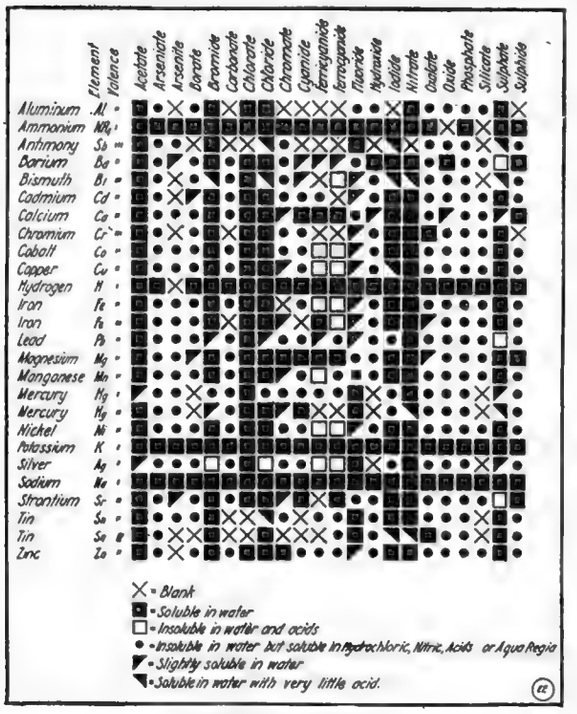


Table of Solubilities.

$$\underset{\text{Potassium Hydroxid}}{2KOH} + \underset{\text{Sulfuric Acid}}{H_2SO_4} = \underset{\text{Potassium Sulfate}}{K_2SO_4} + \underset{\text{Water}}{H_2O}$$

The reasons that two equations of reaction which may take place is more fully explained in the opening of this article.

If desired Sodium Sulfate [Na_2SO_4] can be prepared in the same manner as above.

EXPERIMENT NO. 57—

Neutralize Ammonium Hydroxid [NH_4OH] by the preceding methods, and Nitric Acid [HNO_3]. Make the tests with the red and blue litmus papers. Evaporate as before. The product of this neutralization cannot be evaporated to complete dryness, owing to the fact that the nitrat breaks up.

$$\underset{\text{Ammonium Hydroxid}}{NH_4OH} + \underset{\text{Nitric acid}}{HNO_3} = \underset{\text{Ammonium Nitrat}}{NH_4NO_3} + \underset{\text{Water}}{H_2O}$$

The above salts which were prepared by the neutralization of acids and bases, are *soluble* salts.

Salts can also be produced by the action of acids on metals; below are given methods of preparing chlorids, sulfats and nitrats.

EXPERIMENT NO. 58—

Put into a clean test tube about 5 grams of zinc and pour over it about 10 cc. of dilute hydrochloric acid. It will be remembered that this experiment was performed in a previous installment, [Hydrogen, Experimental; January, 1917, issue Electrical Experimenter]. Apply a lighted splint to the mouth of the tube and notice any familiar action. After the action stops pour the liquid upon a filter; then evaporate the *Filtrat* [the solution obtained after filtering] in an evaporating dish, and note what is left.

The reaction for this experiment is:

$$\underset{\text{Zinc}}{Zn} + \underset{\text{Hydrochloric Acid}}{2HCl} = \underset{\text{Zinc Chlorid}}{ZnCl_2} + \underset{\text{Hydrogen}}{H_2}$$

The gas which escapes from the tube is hydrogen, and by applying a lighted splint to the mouth a slight explosion should be caused to occur. The product obtained in this experiment is Zinc Chlorid [$ZnCl_2$].

EXPERIMENT NO. 59—

Pour about 10 cc. of dilute Sulfuric acid [H_2SO_4] made by pouring 3 or 4 cc. of strong Sulfuric acid *to* the water, about 10 cc., stirring the liquid constantly, and adding the acid in small quantities. [Never add the water to the acid], on about 5 grams of scrap iron. It may be necessary to heat the mixture over the Bunsen burner in order to produce better action. After the action has proceeded for some time remove from the flame, and add about 5 or 10 cc., [after the liquid has been filtered]. After the water has been added to the solution, place in an evaporating dish and proceed to evaporate. The reaction for this experiment is:

$$\underset{\text{Iron}}{Fe} + \underset{\text{Sulfuric Acid}}{H_2SO_4} = \underset{\text{Ferrous Sulfate}}{FeSO_4} + \underset{\text{Hydrogen}}{H_2}$$

EXPERIMENT NO. 60—

Mix 5 cc. of water with about 5 cc. of Nitric acid [HNO_3]. Place about 5 grams of copper scraps in a test tube and add the 10 cc. of Nitric acid, prepared as above. If action does not take place, heat gently over a Bunsen burner. A deep green solution will form, and after the action has stopt, add about 5 or 10 cc. of water and slowly evaporate, as before. If the evaporation is carried to dryness the nitrat will break up into the insoluble oxid, which will manifest a black color. To avoid this action the liquid need not be completely evaporated, but it may

(*Continued on page* 154)

"MAN-HUNTING" WITH THE ELECTRIC CALLING SYSTEM.

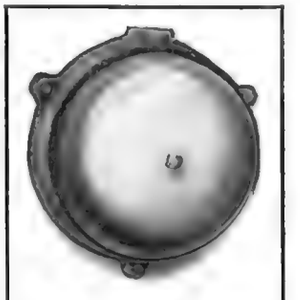
One, two, three—pause—one, two = 32 on the electric calling system here illustrated. It is the prince of man-hunters, serving as it does to quickly summon any particular individual to the nearest telephone, no matter in what part of the plant or shop he may be at the moment.

Keyboard of Electric "Man-Hunting" Machine. It Instantly Summons the Desired Party to the Nearest Telephone.

The Electric Calling System is primarily the operating instrument, which is connected by wiring to a line of signals consisting of either bells, horns, buzzers, lights or whatever other electrical devices it is desired to use. These signals are distributed thruout the establishment in such a manner that every foot of floor-space is within the sound radius of at least one signal.

The Calling System has no direct connection with the telephone, but is usually located, for convenience, near the telephone central station, within easy reach of the operator's hand. The operating instrument may, however, be placed anywhere on the circuit.

This System operates on a voltage of either 110 or 220, A. C. or D. C. It is always in service and there are no batteries to cause trouble or to be recharged. The consumption of current is most economical.



One of the Single Stroke Call Bells.

The instrument is made in one universal model, which has a calling capacity of 45 different code numbers. There is no limit to the number of signaling devices which the instrument will control, provided sufficient current is let into the line to operate them.

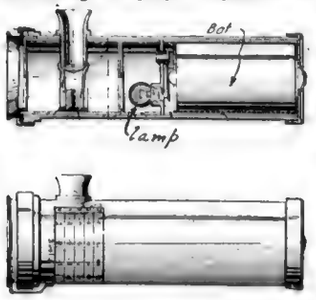
The signals are controlled by eight small levers which form the number combinations.

LATEST PATENTS

An Electric Photometer

(No. 1,218,946; issued to Clayton Laing.)

This device embodies a clever electrically operated photometer for use by photographers in accurately calculating the proper exposure for

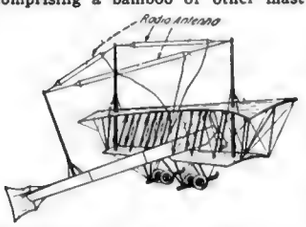


any strength of light and any size lens opening. The instrument comprises a suitable light filter and co-operating shutters, so that ordinary daylight may be properly compared with a standard of light incorporated in the photometer. The light standard is composed of a small electric bulb, and a dry battery with suitable switch. When equal amounts of light penetrate two special translucent blocks, they appear as one block; the two halves of the block perfectly balancing, so that natural and artificial rays are of equal intensity.

Antenna for Aeroplanes

(No. 1,219,550; issued to Walter Hahnemann.)

An improvement in design of wireless antennae for aeroplanes comprising a bamboo or other mast

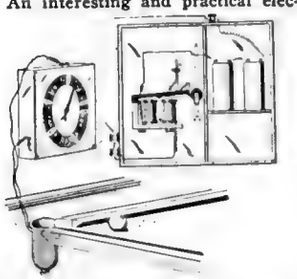


supporting one or more insulated flat-top aerials. The "ground" element is compensated for by utilizing the metallic aeroplane structure; the "aerial" element being cared for by the special antenna here shown. The inventor has paid particular attention to the correct design of aeroplane antennae, with respect to the proper maintenance of the stability and operating characteristics of the aeroplane itself and claims that the addition of his antenna to an aeroplane will not cause it to be unbalanced in flight or in maneuvering.

Pool Table Register

(No. 1,220,420; issued to William H. Heffley.)

An interesting and practical elec-

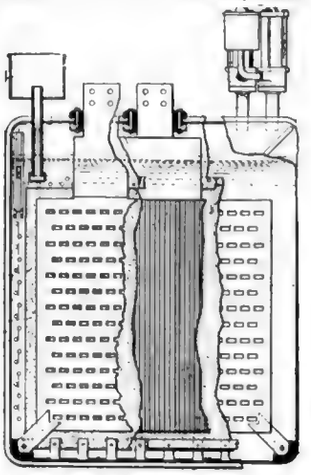


tro-mechanical device for registering the results of a game of pool, etc., whereby the pool ball as it falls into a pocket, closes an electrical contact. This causes a set of magnets to operate a pawl and ratchet connecting with the indicating needle in the manner shown, and the dial may be marked off in any suitable style and colors. The device can be attached to any pool table without altering or damaging it, and each table pocket is connected up to the electrical scoreboard.

Electrolytic Gas-Generator

(No. 1,219,966; issued to Isaac H. Levin.)

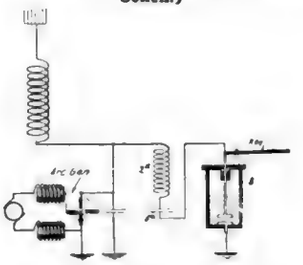
Electrolytic apparatus designed to produce hydrogen and oxygen gases by subjecting water containing a small quantity of a suitable electrolyte, such, for example, as potassium hydroxid, sulfuric acid, etc., to the action of an electric current, which



is caused to flow there-thru from one electrode to another, both electrodes being submerged in water. The solution is decomposed in the well-known electrolytic manner, oxygen being liberated at the positive electrode and hydrogen at the negative electrode. This invention relates particularly to an electrolytic gas generator in which the liquid acted upon is contained in a suitable receptacle, having two sets of insulated electrodes entirely independent of the receptacle proper.

Radio Arc Transmitter

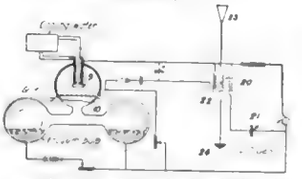
(No. 1,220,072; issued to Louis Cohen.)



Instead of utilizing the "compensation wave" method of radiating telegraphic signals by means of a radio arc type transmitter, the inventor has developed a novel scheme which operates as follows: With the Poulsen system, energy is continuously transmitted, but with this arrangement energy is radiated only as the dots and dashes are sent out. During the "space" periods no current is radiated from the aerial, the high frequency oscillations being shunted thru a variable resistance key 8, condenser 5-a and inductance 2-a. This does not affect the operation of the arc and no appreciable sparking occurs. When the variable resistance key 8, is closed, the loop circuit will have less resistance than the antenna circuit, as it is closed and practically all of the high frequency oscillations produced will flow in this circuit. When the key is opened, the arc oscillations will charge the aerial instead.

Oscillating-Current Generator

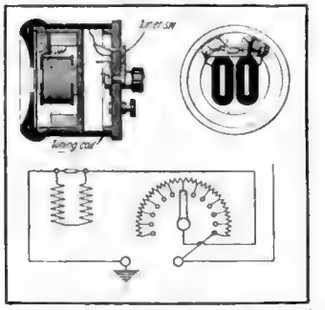
(No. 1,221,034; issued to Lee de Forest.)



An improved method of developing powerful high frequency oscillations with a vacuum tube generator suitably associated with one or more oscillatory circuits. The inventor provides an evacuated bulb containing mercury electrodes, which produce a mercury vapor arc within the bulb. Two cold electrodes 9, and 10, are utilized, 9 being water cooled, and 10 being a bent hollow grid. An oscillating circuit is associated with the two cold electrodes 9 and 10. A second oscillatory circuit is provided thru inductance 20, and capacity 21. With this arrangement, the oscillations produced in the first oscillatory circuit are increased in intensity when the period of the second oscillatory circuit is made equal to that of the first. The output or "load" circuit comprises ground 24, inductance 22 and aerial 23.

Combination Radio Receiver and Detector

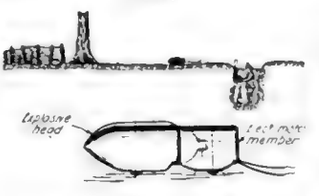
(No. 1,219,888; issued to Frank Wallberg.)



An extremely compact "pocket" wireless set, comprising a tuning inductance, crystal detector and telephone receiver, all in the space required for an ordinary watchcase telephone receiver. The telephone receiver and detector are connected in parallel, and this unit in series with the aerial, ground and tuning coil. The latter is adjustable by means of a switch; the tuning coil is wound about the shell of the receiver, and the detector is extremely small, being placed within the receiver-magnet chamber as shown. The device is held to the ear when in use, and the switch turned until the signals come in the loudest.

Electric Land-Torpedo

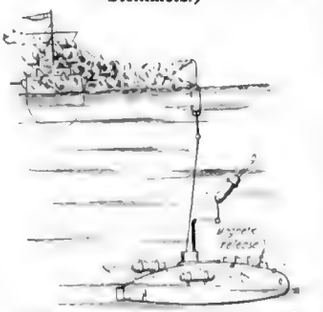
(No. 1,219,028; issued to Abraham Must.)



A novel invention comprising an electrically driven or propelled land-torpedo possessing several unique features. As shown in the illustration, the design comprises two sections; the forward compartment containing the charge of explosives and detonating means, while the pivoted rear unit contains the electric driving motor and necessary gears. The land-torpedo is dispatched from a trench, and is under constant control of a soldier in the trench. It should prove useful in destroying barbed wire, and other impediments, as when it has reached the desired spot, the operator simply pushes an electric button which detonates the explosive charge in the war-head of the torpedo, thus destroying the obstruction. The torpedo hauls its electric feed wires after it, as it ambles away from the trench.

Electric Gas Buoys for Submarine Warfare

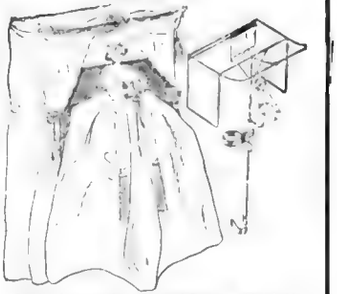
(No. 1,222,498; issued to Joseph A. Steinmetz.)



Something quite new in the realm of war machinery and comprising a series of highly charged poisonous "gas buoys," which may be attached to the exterior of the submarine, and which are held in clamps, electro-magnetically controlled from the interior of the submarine. The latter may submerge in proximity to a hostile war-ship and release one or more of the gas buoys. These float to the surface and even tho struck by shell-fire, they will proceed to liberate a cloud of deadly gas fumes, which are supposed to eventually overcome the crew of the war-ship. The gas buoys may be released and immediately cut free, or they may be maintained in position by a cable as shown, so that they will not drift away before their task is finished.

Hood for Concealing Telephone

(No. 1,221,919; issued to Lillian A. Strasburger.)



This invention provides a specially devised concealing hood for covering the telephone instruments in "My Lady's Boudoir," etc. As shown in the illustration, the device comprises a wire frame-work provided with a spring clip and a doll's head. The attachment is suitably drapt and at the rear it is provided with a sliding curtain. To use the telephone, it is but necessary to grasp the skirt of the figure and turn the whole outfit around 180 degrees, when the rear curtain can be slid sideways and the receiver moved from the hook.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH

Phoney Patents

Under this heading are publisht electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS! $3.00 FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00 ! ! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00 ! ! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of Phoney Patent examiners to issue a Phoney Patent on your invention in a jiffy.

Phoney Patent Offizz

No. $\left(\frac{2\frac{1}{4}\text{ V. A. C.}}{60^{\circ}\text{ S. G.}}\right)$

S. T. Raphangr of Rushour, D. T.

Patent Rattled

SELF PROPELLED TROLLEY

To Whomsever It Might Concert:

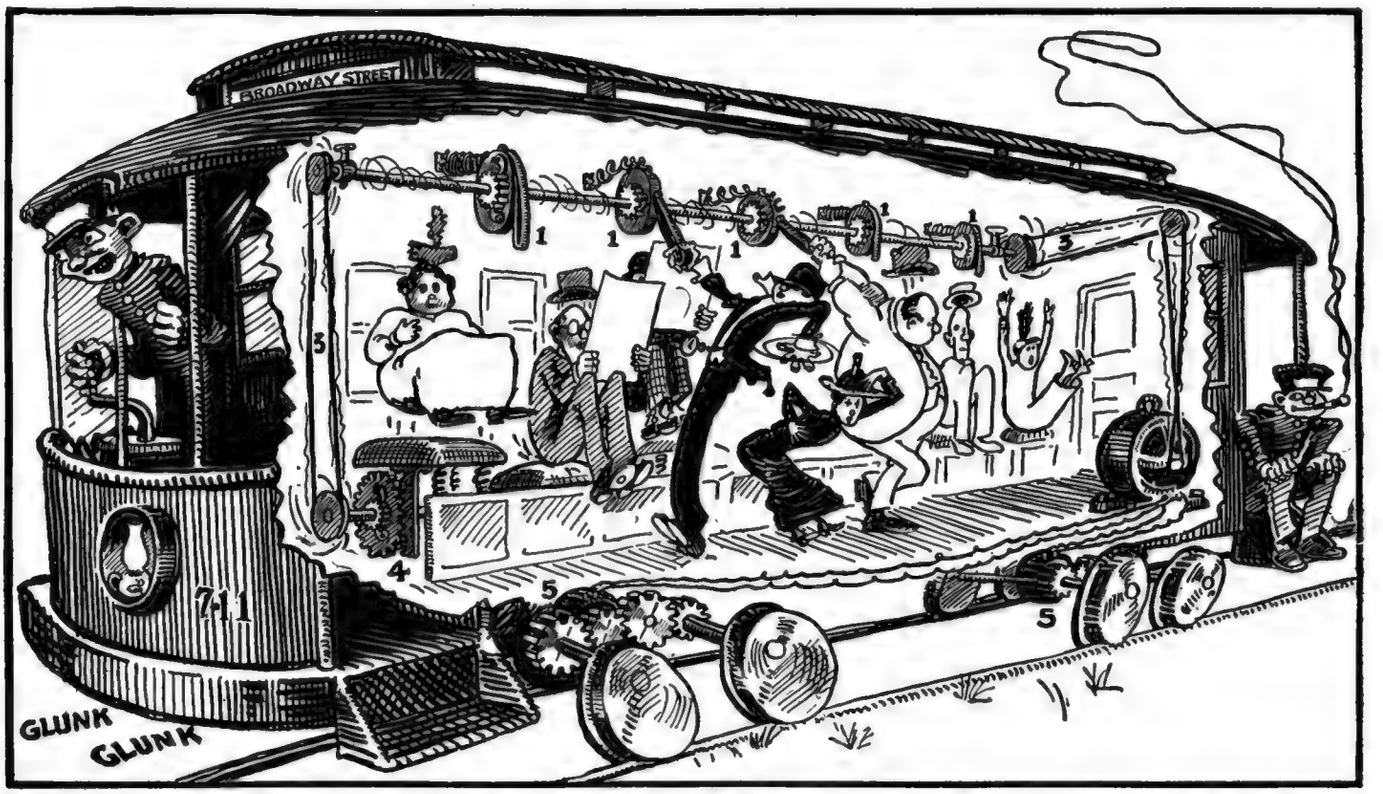
Be it knowed to all unknown and all other straphangers at large, as well as all those confined in solitary confinement thruout the world, that I Salomon Taddeus Raphangr of the City of Rushour in the State of Deliriumtremens, have devised, designed, designated and developed an invention of the most far reaching consequences to a long suffering traveling public.

It is a well known, altho deplorable fact, that the modern trolley car for economic reasons of all traction companies are equipt with rather oval as well as "flat" wheels. The tracks too, are of the scenic railway type, fashioned after the camel's back, *i. e.*, hill and valley with 15 hills and 29 valleys to the running yard. These modern refinements are necessary to shake up and bump the cars vigorously, this action being required to pack the passengers tightly into the car and to jingle the passengers' nickles, so the latter can be extracted easier for the conductor's rake-off.

Having in mind these points and knowing that passengers always sway to and fro in all our trolleys in a truly alarming manner, I conceived the brilliant idea of utilizing this prodigious energy, now going to waste. In my researches I quickly found, that if you start the car on an incline, *no further power is required* to propel it, all the power and lots to spare besides, being furnished by the swaying straphangers themselves. The excess power can be used to light the car and charge a storage battery, which in turn may drive the car when traffic is light. But this is by no means all. By providing all seats with a spring attachment, the seated passengers will bump up and down nicely, and I found this to be far more pleasing than being bumped up and down on hard seats. It is also very healthy, for the digestion is greatly improved, especially after heavy meals. It will "settle" the heartiest meal wonderfully. If the public comes to realize this it will patronize my new self-propelling trolley in a manner undreamt of by the most voracious traction company shareholder. No power house nor trolley wires being required, the company will make enormous profits, and it will be able to issue a package of chewing gum and 10 trading stamps free with every nickel ride.

Referring to the patent drawing we find that 1 is the strap on which the straphanger navigates. Every time he sways he exerts a pull of about 150 lbs. on the strap, and by means of a pawl and ratchet arrangement mounted on a common shaft passing thru the length of the trolley, the shaft begins to rotate. The power is then conducted by belts 3 to dynamo which in turn drives the motors 5 under the car. The motors being geared to the axles drive the wheels of the car. The car wheels being off center, as observed, will give the trolley car a pitching motion like a ship in a swell. This greatly aids in more effectively swaying and bumping the passengers.

The seated passengers when rising up and down on their spring seats operate gears 4 and the resulting power is also conveyed to the belts 3, this furnishing additional power.



Straphangers All Over the Universe As Well As Trolley Car Magnates Will Rejoice At This New Invention. Not Only Do the Swaying Passengers Now Propel the Car, But They Experience All the Variegated Experiences of a Sea Trip and All for a Nickel.

What I claim is:

1° A wireless trolley, operated solely by straphangers.

2° A self propelled fat reducing trolley stimulating digestion and preventing indigestion.

3° A trolley car giving passengers all the experiences of a sea trip for a nickel.

In consternation whereof, I have therefore resolved and caused to be appended and imprest hereunto and hereunder the crest of my family shoe tree with my left uppermost hind foot this 16th day after the "ad"vent of any deceased maiden aunt's German measles, in the presence of three witnesses.

S. T. RAPHANGR.

Wittynesses:
A. W. Gowan,
I. M. Indutch,
C. U. Titout

By his Attorney,
Thomas W. Benson,
Phila., Pa.

QUESTION BOX

This department is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

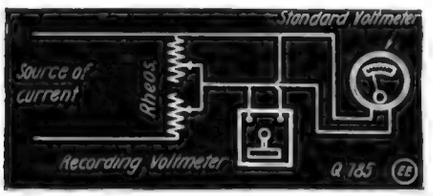
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink; no penciled matter considered.
3. Sketches, diagrams, etc., **must** be on separate sheets. Questions address to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the question entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

RECORDING VOLTMETER.

(785.) J. Hassel, Baltimore, Md., asks:

Q. 1. What is a recording voltmeter?

A. 1. A recording voltmeter is an instrument which permanently records the potential that exists between points in an electric circuit during any definite period. It consists of nothing more than an ordinary voltmeter, the armature or moving element of which carries a small writing pen, that traces a curve on a moving strip of paper. The variation of the e.m.f. in the circuit is indicated by the variation of the traced curve. The strip of paper which receives the record is moved by a special clock mechanism.



Connections for Calibrating a Recording Voltmeter With the Aid of a Standard Voltmeter and Two Rheostats.

Q. 2. For what purpose are these instruments most adapted?

A. 2. They are generally employed in power-houses, where it is required to know the exact voltage conditions of the line during certain periods of the day.

Q. 3. Are these instruments sufficiently accurate to warrant their use in laboratory work? How are they calibrated?

A. 3. No. Most of them require a large correction factor. Their accuracy depends upon the degree of voltage variations, as the friction between the pen and paper is somewhat great when the moving element is caused to move frequently.

The wiring diagram herewith gives connections of a recording voltmeter for calibrating the same with a standard voltmeter.

IMPULSE EXCITATION.

(786.) Paul Magdale, Hackensack, N. J., desires to know:

Q. 1. What is meant by impulse excitation?

A. 1. Impulse excitation is a method of exciting the antenna by means of an oscillatory circuit which is highly damped and the coupled secondary or antenna circuit receiving an impact or shock from the primary circuit, and permitting this secondary circuit to oscillate with as little damping as possible. The primary oscillatory circuit is so adjusted or tuned that a *single impulse* is produced.

Q. 2. Is the quenched spark gap system operated on the impulse excitation principle?

A. 2. Yes; but it is not an ideal impulse excitation, since the primary of the circuit is not permitted to be highly damped. Furthermore, the oscillations of the primary are periodically cyclonic and not impulsive or semi-period oscillations, as that obtained from an ideal impulsive excitation transmitter.

RADIO BOOKS.

(787.) Andrew Colly, Oyster Bay, L. I., asks:

TO OUR FRIENDS.

Do you realize that not one day passes when we do not receive from 150 to 250 or more letters addrest to the "Question Box"? If we were to publish all the questions and answers we would require a monthly magazine five or six times the size of The Electrical Experimenter with no other matter but questions and answers! Of late the influx of letters has become so heavy that several of our associates have been forced to discontinue important editorial work, in order to answer the mail. This we are certain you do not wish. You do not want your magazine to lower its present high standard. You want the best, the very best, and you know we never have failed you yet.

Moreover the multitude of letters are wholly unnecessary. Most of the questions we are asked every day have been answered before in the Question Box. Therefore ere you sit down to write to us, look over your back numbers and nine times out of ten you will find the answer.

We strive hard to publish only such matter as has not appeared before in our columns, and for that reason only a small fraction of queries of those received by us are actually publisht.

Kindly note, therefore, that in the future we cannot, in your own interest, answer questions by mail, free of charge.

For questions requiring immediate answer our fee is 25c. for the first ordinary question and 25c. for each additional question. We will gladly advise fee for special questions entailing considerable calculations or research. Stamped and addrest envelope should be enclosed with the queries and, moreover, any sketches accompanying them should be made on separate sheets. And please be brief.

THE EDITORS.

Q. 1. Where can I buy wireless books describing in detail the complete theory of radio engineering, and also a text-book giving complete data as to the design and operation of radio apparatus?

A. 1. We would recommend the following books, which we believe will give you all the desired information: By J. A. Fleming, "The Principles of Electric Wave Telegraphy," $10.00; by J. Zenneck, "Wireless Telegraphy," $4.00; Eccles' "Wireless Telegraphy and Telephony," $3.50. We will send any of these books on receipt of price.

Q. 2. Are all the Radio Amateurs of this country to remove their aerials and apparatus in this present crisis?

A. 2. Orders have already been given to instruct all Amateurs thruout the country to remove their aerials. The instruments were not asked to be removed or confiscated by the authorities up to the present time.

WIRING DIAGRAM.

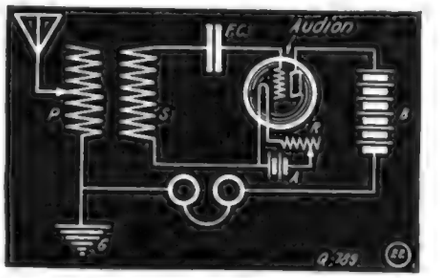
(789.) Peter Hancock, Toledo, O., wants:

Q. 1. A wiring diagram of a short wave regenerative Audion receiving outfit.

A. 1. The appended diagram gives the proper connections.

Q. 2. How can I eliminate the noises produced in the receiver when the Audion is in operation? This effect is even obtained when the receiving instruments are disconnected from both the aerial and ground.

A. 2. The noise which you are experiencing is due to a constant electrical charge on the grid of the Audion, which causes the grid condenser to charge and discharge unperiodically; consequently affecting the receivers. This trouble might be eliminated to a certain degree by shunting a high resistance "leak" path across the grid condenser. It must be a non-inductive leak and can be made very readily by marking upon a sheet of paper a pencil mark and connecting the ends of this line across the condenser. A little patience in making the proper thickness of line will be required before proper results can be obtained.



Hook-up for a Short Wave Regenerative Audion Radio Receiver.

WAVE LENGTH OF ANTENNA.

(790-A) Thomas Lowman, East Pittsburgh, Pa., inquires:

Q. 1. Can you give me the wave length of an antenna which consists of four wires 60 feet high, 100 feet long, and the wires separated 2 feet?

A. 1. The wave length of this antenna is 300 meters.

Q. 2. Suppose I desire to use this antenna with a transmitting station, which will comprise a 500 watt 60 cycle trans-

(*Continued on page* 137)

Who Gets $200,000,000 Tire Profits?

An amazing condition revealed in the tire business. Terrible waste shown by methods of selling automobile tires. How one tire man plans to cut the cost of tires to the consumer revealed

Tire Chain Stores Offer Solution of Problem

By M. E. PHILLIPS, "Staff Correspondent" (Home Magazine)

NOTE.—The following article, written by our staff representative, outlines plans for a giant chain of tire service stations and stores which it is predicted will greatly lower automobile upkeep costs. A unique co-operative plan which has been tested out and found successful. Output of splendid factory already secured, more to follow. The success of other chain stores and the tremendous growth of the automobile industry—consequently of the tire business—makes this one of the most attractive and interesting enterprises. We have made every effort to verify the statements made here and to the best of our knowledge the statements are accurate and the estimates conservative.—(Publisher Home Magazine.)

Who gets the $200,000,000.00 A YEAR TIRE PROFITS?

Do you know that the cost of producing a tire is possibly ONE-THIRD of the price you have to pay? That a small tire you pay $15.00 for costs about $5.00 to manufacture? That the tire costing about $20.00 to build *has to retail for about* $60.00?

Do you know that the tire manufacturer is satisfied to sell his tires for very little over the cost, and at only a fraction of the retail price?

Where does the balance go?

Who then gets this enormous "cut in" on the tires you buy?

DO YOU? Of course not.

Who, then?

Well, the JOBBER gets a BIG slice.

The WHOLESALER gets another BIG slice.

The RETAILER gets HIS SHARE.

The rest goes into advertising, dealer's helps, adjustments, etc.

Meanwhile YOU, Mr. Tire Buyer, pay the 100 per cent price and worry about the high price of upkeep of your motor car.

WILL CUT TIRE COSTS

A clever tire man, a man with intimate knowledge of the tire industry, a man with breadth of vision and economic principles, has seen this enormous WASTAGE in the tire business and has evolved a PLAN that will revolutionize the tire selling business.

The Famous Philadelphia Experimental Tire Service Store that Proved to President Feist of the National Rubber Company the Practical Possibilities of Tire Chain Stores, Located at the Corner of North and Broad Streets.

He argues that TIRES COST THE CONSUMER TOO MUCH.

He says there is no reason on earth why the tire buyer should have to pay this enormous burden of profits and selling costs. If tires can be made for ONE-THIRD of the actual retail prices they can be sold FOR LESS than prices now charged for them and still pay legitimate profits. LARGE PROFITS, because of the volume of business a company offering such savings is bound to achieve.

This far-sighted man is a PRACTICAL TIRE MAN. As a manufacturer he has MADE GOOD. He is a PRACTICAL BUSINESS MAN, with all a practical man's dislike for waste. He has proved his genius for organization and big things.

This man is Mr. J. G. Feist, President of the National Rubber Company of New York.

PLANS CHAIN OF STORES

Mr. Feist's plan is to establish a chain of tire service and store stations from Maine to California, and Canada to the Gulf of Mexico.

The National Rubber Company of New York has been organized with strong men behind it and it has already secured the output of one entire factory as the nucleus of this chain store plan. More factories will be added as the chain extends and the need of more tires becomes evident. The first factory whose product has been acquired is the National Rubber Company of Pottstown, Pa., manufacturers of the famous National Speedway Tires and National Red Tubes.

The NATIONAL SPEEDWAY REDWALL TIRES are so GOOD that they are sold under the strongest GUARANTEE to be had.

The company agrees to replace FREE any tire that does not outlast and outwear any tire of any make or price of the same size tested under the same conditions.

This company now has a production of 1,000 tires and tubes a day and is being enlarged to a much greater capacity. When the distribution exceeds the capacity of this plant, new plants will be started or bought in different sections of the country, or their outputs contracted for in order to bring up the production to the necessary number of tires.

Mr. Feist proposes to sell tires at a MUCH LOWER PRICE than is now being charged for good tires elsewhere.

He plans to give SUPERIOR SERVICE to tire buyers.

He will give them a BETTER TIRE. He anticipates that in doing this his company *will prove the greatest profit maker in the country.*

EXPERIMENTAL PLANT A SUCCESS

Mr. Feist is not building his company's future on imagination or theory. Before maturing his plans he opened in Philadelphia

Boston Service Store of National Rubber Company, Located at 557 Columbus Avenue.

a station such as he proposes to establish elsewhere.

This is what his Philadelphia service station and store does:

It sells tires below the average price of high-class tires of equal size and quality.

It delivers tires PUT ON YOUR CAR.

You phone in that you need a 34x4 tire and give your address. A mechanic picks up the required tire, puts it in the carrier of a motorcycle and speeds off to your address. On arrival he takes off your old tire and puts on the new one. No trouble, no mess.

If you want your old tire repaired he takes it back with him and it is delivered as soon as repairs are made.

You have saved time, labor, worry and *money.*

The success of this first service station PROVES what REASONABLE PRICES, HIGH QUALITY GOODS, EFFICIENT SERVICE will accomplish. Profits are large because of volume. The Philadelphia service station already has 11,000 CUSTOMERS. (Not tire sales, but CUSTOMERS.)

With this established PROOF of the value of this new departure service, Mr. Feist has organized a company to establish National Rubber Company SERVICE STATIONS and stores all over the country. His plan provides for opening 500 stores the first year, if possible, and more stores year by year as the company grows.

OFFERS GREAT OPPORTUNITIES

The OPPORTUNITIES offered by this chain of tire service stores are self-evident.

CHAIN STORES of all kinds have been enormously successful. They have built up some of the greatest fortunes in the country. They have made original investors enormously rich. And this in spite of the fact that most chain stores have dealt only in articles selling for a very small sum. HOW MUCH GREATER should be the profits of a chain of stores selling a product whose every SINGLE SALE equals the sale of HUNDREDS of the articles sold in most chain stores?

The UNITED CIGAR STORES, selling cigars, cigarettes and tobacco, average LESS THAN 20 CENTS PER SALE. The National Rubber Company averages MORE THAN $20 PER SALE, with proportionate profits.

THE WOOLWORTH STORES sell 5 and 10 cent articles. Yet they have made many millions and the highest office building in the world was built out of these nickels and dimes.

The REGAL SHOE COMPANY with its chain of hundreds of shoe stores, has made its owners rich. So have the Walk-Over Shoe Stores, the W. L. Douglas Shoe Stores. All chain stores.

The TRULY WARNER Hat Store chain has accumulated wealth for its owners.

The Great Atlantic and Pacific Tea Stores, the Jewel Tea Stores, the Acme Tea Stores, all chain stores, have made millions.

The several chains of drug stores, of grocery stores, of cheap restaurants, have all made fortunes.

The reasons for this uniform success are numerous.

In the first place, operating a "chain of stores" of any kind reduces the cost operation—what is known as OVERHEAD EXPENSE—to the minimum.

Secondly, the purchasing power of the buyer who buys for hundreds of stores is so enormous that he can pretty nearly make his own price. He gets ROCK BOTTOM costs on everything. Woolworth can sell for 5 or 10 cents articles that often retail at from 25 to 50 cents because he buys outright entire factory productions. The manufacturer who sells his whole output to one man for cash, eliminates all selling expense, salesmen, advertising, collections, etc., and can sell for a quick turnover, and will yet make more profit in the end. That's how the chain store buyer can buy at such a low figure that he can sell goods that retail generally for 25 cents for 5 and 10 cents.

Then, the chain store man nearly always buys FOR CASH. That means he takes advantage of every cash discount and by paying cash he enables his manufacturer to buy for cash and get a similar benefit. So it becomes an endless chain of savings which benefits the ultimate consumer of the product.

ECONOMY OF CASH BUYING

The chain store man uses his cash to buy everything. He buys everything the same way. He buys his fixtures, his delivery wagons—if he uses them—his every necessity at the lowest bulk price, and bulk with the chain store man means tremendous bulk.

If these chain stores, selling articles that retail for such a small price, can earn such fabulous dividends, what will a chain of tire service stores earn with the big sales it will make; sales averaging $20 apiece?

It doesn't take a prophet to look into the future and see the magnificent accumulations of dividends that should accrue from such an enterprise.

It isn't hard to foresee what the earnings of such a chain of stores can pay in say ten years from today. By that time the chain should extend to every city of any importance in the country. This may mean thousands of such stores, because there are in the United States 1,442 towns of 5,000 or more inhabitants and over 100 cities having a population of 55,000 or over. The small towns, say the towns under 10,000, would require only one such service station, while the larger towns would require a number of them.

THOUSANDS OF CHAIN STORES

To give you an idea of how many stores some of the big chains have, it is enough to mention the Great Atlantic and Pacific Tea Company, with over 1,500 retail stores; the United Cigar Stores, with over 1,000 retail stores; the Woolworth Company, with over 1,000 stores, etc.

The tremendous growth of the automobile industry—a growth that is gathering size and importance every day—makes this projected chain of tire service stores all the more important.

At the beginning of 1917 there were approximately THREE MILLION autos in use in the United States. According to last United States census, there were in 1910 (date of last census) 91,972,266 inhabitants in the U. S. It is calculated that there are now at least 120,000,000 people in the U. S. At this rate, there is one auto in the U. S. for every 40 people. In many of the states, the ratio is higher than one for every 16 people. This means that THERE IS A TREMENDOUS POSSIBILITY FOR MORE MACHINES.

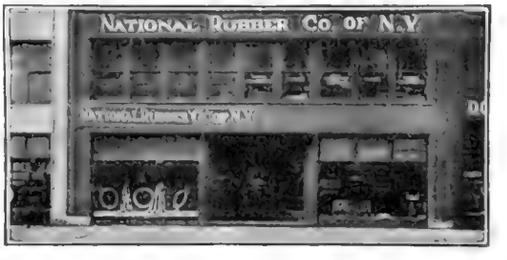
According to the best informed automobile authorities, it is calculated that there will be added at least 1,000,000 auto users during the year 1917, bringing up the total close on to *FOUR MILLION AUTOS in actual use in the U. S.* With such an *enormous* distribution of cars, and all the automobile factories of any account way behind in deliveries, an enormous supply of tires will be required to keep these autos running.

24,000,000 TIRES NEEDED

Very moderate estimates place the number of tires required on each car at EIGHT PER YEAR. Each auto MUST HAVE FIVE TIRES, four on the wheels and one spare tire. It is an ultra conservative estimate, therefore, that places the required number of tires to meet the needs of 1917 at SIX PER CAR. At this rate 4,000,000 automobiles will require 24,000,000 tires. This is truly AN AMAZING FIGURE for an industry that is only a little over a dozen years old.

The distribution of these cars is centered at present in certain sections. When the other sections have awakened to the advantages and uses of the automobile and its economy for travel and commercial purposes, it is more than likely that the distribution will be much more even.

It has been estimated by statisticians that there are *OVER TEN MILLION men in the U. S. who should be, and probably*



Chicago Store of National Rubber Company, the Third in the Chain.

soon will be, auto owners. These are men who, because of their business, their financial condition and their position, should become automobile owners.

There are upwards of seven million farmers in the U. S., and of these a large percentage will probably become owners of automobiles. Just now only about 7 per cent of the prosperous farmers own automobiles. The farmer is today the RICH MAN of the U. S. He has been getting the biggest prices ever paid for crops, he has by scientific farming increased the yield of his acres, and he has been fortunate in getting big crops when the price was highest.

For these reasons, THE FARMER IS USUALLY PROSPEROUS and he is putting some of his riches into the comforts and conveniences of an automobile.

With such prospects, with such a tremendous field to conquer, with the SUCCESS that has attended the FIRST UNIT of the National Rubber Company chain of service stores, it is not hard to visualize the ENORMOUS POSSIBLE PROFITS from this enterprise.

Officers and Officials of the National Rubber Company of New York. These Men Have Made the Making and Selling of Tires Their Life Work, Both as Manufacturers and Branch Managers. They are Pioneers in the Tire Business; They Have Watched the Tire Business Grow from the Experimental Stage. Today They are Large Factors in the Manufacturing of the Best Tire that Money Can Make. Mr. Walsh, Who is Superintendent of the Plant, Has Been for 23 Years in Active Charge of the Making of the Best Known Tire in America. Mr. Sperry Was With the Deere Plow Co. as Agency Organizer. Mr. Dougherty Has Been a Tire Representative for Years, Formerly With the Lee Tire Co. H. A. Lamoree Has Also Been a Branch Tire Store Manager and General Tire Salesman With Several of the Big Companies.

HOW PROFITS PILE UP

Even a casual consideration of the subject makes the figures run into such amazing columns of profits that the very thought is staggering.

The great earnings of chain stores of all kinds has been in the aggregate.

When you take 1,000 stores and pile their profits in one great heap, you have a formidable aggregate—an aggregate which doesn't have to be very large in the individual case to make up this magnificent total.

Let us take into consideration one unit and then see how it works out.

Firstly, we must remember that these service stores are operated at a *minimum of expense.* Being administered from the central office, whose costs of operation are spread over the whole chain, the local stores require only inexpensive help. The man who operates a store of his own expects to make A GOOD LIVING out of it for himself AND A GOOD PROFIT besides; he has to pay for everything on the high price of individual purchases. He has to have efficient help, has to advertise and, of course, he has fixed charges for rent, light, taxes, insurance, etc.

CHAIN STORE SAVINGS

The chain store hires only the necessary help, it eliminates the owner's living and profits. It buys in enormous quantities at prices that make the prices the individual store owner pays seem preposterous; it pays the minimum for taxes, for insurance and the advertising expense of operating is carried in bulk by the parent company, and this is divided pro rata so that each individual store pays only a small sum as its share of the advertising expense.

Tires are bought at actual contract price from the manufacturer and so charged agains the store, much cheaper than the average tire store man can buy them.

We then have EXPENSES PARED DOWN TO THE BONE, probably HALF WHAT THEY WOULD BE UNDER ORDINARY CONDITIONS. And we have the most attractive kind of a proposition to offer to the tire buyer—THE BEST TIRE ON THE MARKET AT MUCH LESS than he would have to pay elsewhere; A SERVICE NO OTHER TIRE CONCERN GIVES or can give, GUARANTEED SATISFACTION backed up by a company operating a nation-wide chain of stores.

With so much to offer and with such splendid profit-making advantages it is not hard to look into the future and see every store paying a big profit and the company earning dazzling dividends.

What may one store earn, you may ask?

Let us do a little figuring:

Firstly, the ENTIRE FACTORY SELLING EXPENSE IS ELIMINATED—the entire output of the factory being sold to one customer—the chain store.

The saving of the traveling expense and salesman's salaries and commissions. The saving of advertising and promotion expense. The added office accounting and credit expense. All these are SAVED by the chain stores. In these items alone is found a selling cost of at least 20 per cent.

On top of that the JOBBERS' DISCOUNT OF 40 PER CENT IS WIPED OUT.

No thinking man or woman has to be told that the NET SUM the manufacturer receives ALONE CONTROLS THE QUALITY AND QUANTITY of materials used in making tires, because ONLY AND SOLELY from this NET SUM is the PROFIT derived.

Because of the TREMENDOUS OVERHEAD selling and distributing expense, the enormous discounts demanded by the jobber, the wholesaler and the retailer, if the manufacturing cost were TOO HIGH or even over his competitors, then added charges, as described here, increase out of proportion and the consumers' prices would be prohibitive.

Hence, in National Speedway Tires most of the factory selling cost is put in the tire in ADDED QUALITY AND QUANTITY, and the usual trade discounts are divided with the consumer.

PROFITS OF CHAIN STORES

We now come to the question of the profits of the chain stores of each unit and of the chain in the aggregate.

After a careful scrutiny of costs of manufacturing, of operating the chain store—each unit—and figuring a retail price on the tires at a sensible reduction over average price of tires of equal size and quality we find that there is still possible an average margin of $5 per tire. This is "AVERAGED" because some of the tires will pay more profit while some will pay less, but the average has been shown to be *about* $5 *per tire sold.*

This is evidently a CONSERVATIVE ESTIMATE.

If each chain store sells ONLY 10 TIRES PER DAY, we have each store earning a profit of $50 a day or $50,000 a day profit for 1,000 stores.

$50,000 profit per day for 365 days in the year—tire service stations are busier Sundays and holidays than other days—FIGURES OUT THE ENORMOUS TOTAL OF $18,250,000 A YEAR PROFITS.

You will realize that an estimate of only ten tires per day is very small. When you consider the tremendous advantages of dealing with the National Rubber Company service stores, the high class product, the low price, the good service given in the way of instant special deliveries, placing the tire on the car and taking away the injured tire for repairs, it is not hard to understand why these stores should do an enormous business.

Ten tires per day is a very low estimate of the possibilities, but to be even more conservative, let us cut down this estimate by half. Let us suppose that the stores only AVERAGE FIVE SALES PER DAY. Let us see how this figures out.

FIVE TIRES A DAY, showing an average profit of $25 per day per store, one thousand stores will, therefore, pay an estimated daily profit of $25,000. For 365 days in the year, THE ENORMOUS TOTAL WOULD BE $9,126,000, and it would be a mighty small store that couldn't sell five tires per day.

These figures are staggering when you analyze the accumulated profits of hundreds of stores all over the country, each contributing its quota of profits from many sources.

A GOLD MINE OF PROFITS

You will note that no estimate has been made of profits from sale of tubes and from the repair department, which should also be profitable.

It will, of course, take time to build up such a large chain of service stations, but in a few years, with the growth of the chain and the enormous increase in the automobile industry and number of cars in use, THIS CHAIN OF TIRE SERVICE STATIONS SHOULD BECOME A VERITABLE GOLD MINE OF PROFITS FOR EVERY STOCKHOLDER WHO BECOMES INTERESTED IN THIS COMPANY NOW, when its shares can be acquired at a low initial price.

The National Rubber Company, of New York, is incorporated under the laws of the State of Delaware, with a capitalization of 500,000 shares of the par value of $10 PER SHARE, ALL COMMON STOCK, SHARING EQUALLY IN PROFITS AND CARRYING FULL VOTING POWER.

THE STOCK IS FULL PAID AND NON-ASSESSABLE.

For the purpose of establishing the business on a right basis, the directors have set aside 100,000 SHARES OF THIS STOCK TO BE SOLD TO THE PUBLIC.

Their idea is that by obtaining a wide distribution for this stock, they will enlist local interest in the local distributing and service stations of the National Rubber Company.

UNDERWRITING STOCK OFFER

This UNDERWRITING SYNDICATE STOCK is offered in five different allotments.

The first allotment will be sold in lots of not less than TEN SHARES and not more than 100 shares at $5 per share, or half the par value of the stock.

This first allotment of 20,000 shares is the only stock of the UNDERWRITING allotment that will be sold at this low price. The next allotment will probably be sold at from 40 to 50 per cent advance in price as soon as the first allotment of 20,000 shares is disposed of. Further allotments at further increases as warranted.

It is desired—as nearly as possible—to place every share of this UNDERWRITING stock in the hands of owners, or prospective owners, of automobiles, who will become immediate patrons of the chain stores and who ARE ALSO OFFERED AN INDUCEMENT TO BECOME BOOSTERS FOR THE TIRE SERVICE STATIONS. THIS INDUCEMENT CONSISTS OF A CASH DISCOUNT OF 25 PER CENT UNDER THE STANDARD LIST PRICES FOR ALL TIRES SOLD BY THE NATIONAL RUBBER COMPANY TO ITS SHAREHOLDERS.

An automobile owner, therefore, has a double interest in buying this stock.

The saving alone in tire bills for a year should pay for this ten shares if he buys at this price and he will have, besides the savings in tire costs, and dividends which the company declares.

IS THIS INVESTMENT WORTH WHILE, you may ask?

WHAT THIS MEANS TO AUTOISTS

Let us study it over. $50 invested in ten shares of this underwriting stock will save the automobile owner 25 per cent on his tires. If his bill for tires runs to $200 a year, he will be saved, therefore, $50. That means that the stock will have paid him 100 per cent on his investment or 50 per cent on the par value of the stock, which, computed on a stock's ability to earn 5 per cent, will make his TEN SHARES REPRESENT AN INVESTMENT OF $1,000 FROM AN ORIGINAL INVESTMENT OF $50. Then if the company begins paying dividends, the stock should go to par and over if the dividends amount to more than 5 per cent.

When the company gets on a 10 per cent dividend basis, the stock he bought for $50 should represent an investment of $200. When it pays 50 per cent, it should have an INVESTMENT VALUE OF $1,000.

Section of Tire-making Department. Here a Small Army of Workmen Are Constantly Employed Putting the Finishing Touches to National Redwall Speedway Tires. These Workmen Are the High-skilled Labor and Their Rapidity and Efficiency Are Wonderful.

So when the company is in a position to pay 50 per cent dividends, this stock should represent an investment to the automobile owner of $2,000, figured on the basis of the dividends and savings it will give him on his tire purchases. And all from an original investment of $50.

When the company reaches its full development and its 1,000 or more stores begin piling up big profits, such as we have already figured on, profits that mean exceptional dividends, THIS ORIGINAL INVESTMENT WILL HAVE ACCUMULATED A PHENOMENAL VALUE.

NO AUTOMOBILE OWNER CAN AFFORD TO OVERLOOK SUCH AN OPPORTUNITY.

A blind man could see the possibilities presented in this underwriting offer, an offer so liberal that the directors had to confine it to a small amount of stock.

AN EXCEPTIONAL OFFER

The offer of the stock at $5 per share (par $10) is in itself a tremendous inducement, but when it is coupled with the offer of the company to extend *a discount of 25 per cent on all tire and tube purchases made* through the company, it becomes so extremely attractive a proposition that NONE CAN AFFORD TO IGNORE IT.

The savings in tire costs alone should pay for the stock of those who accept this offer.

The Splendid Modern Character of This Ideal Plant Is Shown Clearly In These Pictures, With Its Strong, Clear Light, Fine Equipment and Good Flooring. Ideal Conditions for Turning Out High-class Work.

This, in itself, makes the proposition attractive. But when the future of this company is analyzed and the possibilities it offers are considered, the offer becomes immensely more attractive.

YOU NEED NOT NECESSARILY BE AN AUTOMOBILE OWNER today to accept this offer. Your stock in the National Rubber Company will entitle you to this 25 per cent discount on tires and tubes JUST AS LONG AS YOU REMAN A STOCKHOLDER. Later, when you buy an auto, you'll be able to buy tires at this great saving.

You often hear it said that if you had a chance to invest with Ford, or Willys, of Overland fame, with Goodrich or Fisk or Firestone; with Westinghouse or Bell, or some of the others, whose companies have earned fabulous dividends, and made stockholders rich, you would today be ON EASY STREET.

This is very true but the pitiful truth is YOU DID NOT HAVE THIS CHANCE. VERY FEW PEOPLE DID. These com-

panies were all close corporations with the stock held in the hands of a small group of men. These stocks were not offered to the public.

Tire Fabric Cutting Machine. This Machine Can Cut the Fabric for 1,000 Tires a Day, Doing the Work of 10 Men.

A CHANCE IN A MILLION

BUT HERE IS A CHANCE. Here is a company offering UNDERWRITING STOCK, stock that can now be bought at the ROCK BOTTOM PRICE, that should in time become enormously remunerative. Stock in a company that promises to have tremendous growth.

Woolworth and Whalen and the others, who have made tens of millions out of chain stores, never gave the public a chance to come in on the organization. They have sold stock since, lots of it to the general public, but it has been stock in the developed proposition, stock that has been sold on the market AT THE VALUE IT PRESENTS NOW, a value figured on the company's earning power.

LATER YOU MAY GET A CHANCE on the National Rubber Company stock on the open market but YOU'LL PAY THE PRICE OF DEVELOPED STOCK. If the company is earning 100 per cent on its capitalization, you'll pay for it at that rate, which, in that case, would be $2,000 for every $100 par value, or $200 a share for $10 shares.

Tire-Making Machines. A Busy Corner in This Department. These Four Machines Shown in the Picture Do the Work of 40 Men. This is the Most Modern Tire-making Machine Built.

THIS IS THE PENALTY THAT SHORT-SIGHTED PEOPLE PAY for not accepting opportunities that are offered them.

The poorhouse is FULL OF SUCH PEOPLE, "THE MIGHT-HAVE-BEENS."

They lacked the initiative and courage to back their belief with their money.

THOSE WHO HAD COURAGE

The others, those who are without fear, those who have the courage to back their judgment with their money, they are those you watch spinning past you on the boulevard in luxurious limousines, whose homes line the fashionable streets.

MONEY MAKES MONEY, but it takes an exceptional opportunity to bring you big returns from small investments. You read, for instance, that $500 invested in such-and-such stock has earned $250,000; that $500 invested in such other stock has paid $200,000; that $1,000 in Ford stock of the original company is now worth millions. THAT IS ALL TRUE, gospel truth, BUT did YOU ever get a chance to invest in the original $28,000 that started Ford on the highroad to his present millions? Did you get a chance to invest in the $33,000 that John N. Willys has built up into the tens of millions of the Overland Company? Did YOU get a chance to get in on Westinghouse, or Bell Telephone, or Western Union, or Welsbach Mantles stock? Of course not. And very few people did BECAUSE THESE STOCKS WERE NOT OFFERED TO THE PUBLIC when they were at a low price.

THERE'S A REASON

This stock is offered for a reason.

It is offered to the UNDERWRITERS of this company to start it with a nucleus of interested tire buyers and boosters in every locality.

The directors set A MINIMUM OF TEN SHARES AND A MAXIMUM OF 100 SHARES on this offer. It would doubtless be more profitable to the company if every subscription for this stock was for $50 (10 shares), par value $100, because that would mean that the greatest number of people possible would be holding the stock and boosting for the company.

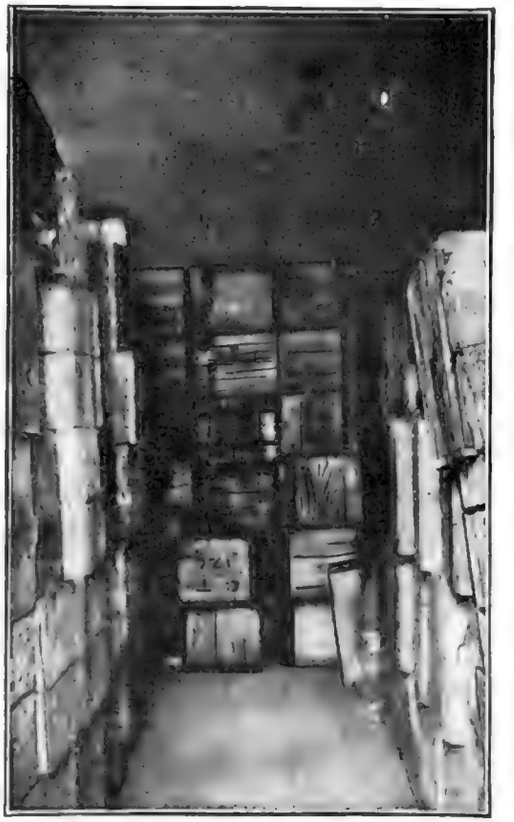
Vulcanizing Department of the Pottstown Plant. Here the National Speedway Tires Are Hardened to Stand Wear and Tear. This Department is Now Vulcanizing 1,000 Tires a Day.

Ten thousand holders of stock scattered throughout the country would mean a veritable army of boosters, helping build up the business IN WHICH EACH ONE HAS A SOLID, SUBSTANTIAL INTEREST.

Ten thousand boosters, working to popularize and make known the high quality of National SPEEDWAY RED-WALL TIRES and National Red Tubes—boosting this way because it is TO THEIR INTEREST to boost this way—would save the company tens of thousands of dollars per annum in advertising expense.

That's the principal REASON WHY THIS STOCK IS OFFERED TO YOU AND TO EVERYONE WHO BUYS TIRES OR EXPECTS TO BUY TIRES.

It is WORTH IT to the company to make you EVERY INDUCEMENT to buy this stock. AND IT IS CERTAINLY WORTH WHILE TO YOU TO BUY IT. Remember you profit immediately because as soon as you are a stockholder you can save 25 per cent on all the tires you buy.

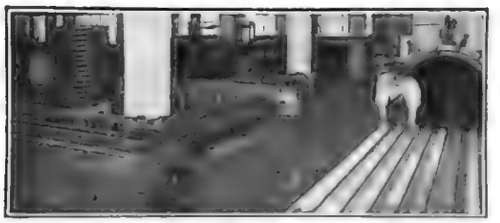


Rubber Vault. In This Vault Are Stored Thousands and Thousands of Pounds of Uncured Rubber for Tire and Tube Making. It is Stored Here Just as It Comes from the Ships.

WAITING FOR A MIRACLE

Every man hopes, some day, that by some wonderful miracle he will be lifted out of the life of drudging toil he leads into one of affluence, comfort and independence. It is our nature to live in this HOPE. But the day of miracles is past. Good fairies do not run around with bags of gold and drop them into the laps of the worthy.

YOU'VE GOT TO HELP YOURSELF TO FORTUNE. You've got to save to get a nucleus of money to invest where



Tube-making Department. Here Are Made the Famous National Red Tubes. The Factory Is Producing 1,000 Tires a Day.

the opportunities for profit are large. BUT YOU'VE GOT TO INVEST YOUR SAVINGS, if you want them to pay big returns.

One of the world's greatest bankers has said that NO MAN WILL EVER GET RICH FROM THE SAVINGS OUT OF A SALARY OR WAGES. He must accumulate wealth by PUTTING THESE SAVINGS TO WORK, INVESTING THEM TO ADVANTAGE.

Of course, it takes COURAGE to invest money that you have worked hard for, that has been slowly and laboriously accumulated by privations and sacrifices. But IT IS THE COURAGEOUS WHO WIN THE EARTH.

DON'T INVEST ALL YOUR SAVINGS. That wouldn't be the wise course. Keep a reserve of your savings for eventualities, for sickness or loss of position or unexpected calls, BUT INVEST PART OF YOUR SAVINGS WHERE THEY CAN EARN YOU SOMETHING WORTH WHILE.

INVEST FUTURE SAVINGS

Or better still, HERE IS A PLAN BY WHICH YOU CAN ACQUIRE THIS STOCK WITHOUT TOUCHING YOUR SAVINGS.

BUY WHAT YOU CAN AFFORD TO PAY FOR OUT OF YOUR NEXT SAVINGS

The directors have made it EASY FOR YOU TO GET THIS STOCK AND PAY FOR IT OUT OF YOUR FUTURE SAVINGS.

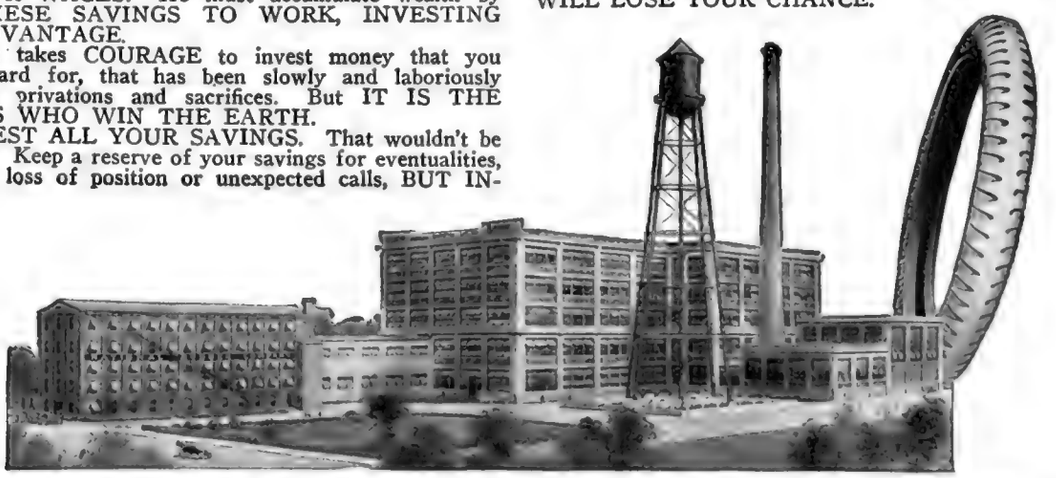
You can pay down $10 ON EVERY TEN SHARES OF STOCK YOU WANT AND PAY THE BALANCE IN FOUR EQUAL PAYMENTS OF $10 A MONTH for each 10 shares, making the total of $50 for the ten shares, par value $100.

This liberal plan makes it possible for you to buy this stock and pay for it WITHOUT TOUCHING THAT PRECIOUS CASH RESERVE you have been accumulating in the bank so carefully.

BUT WHATEVER YOU DO, DON'T OVERLOOK THIS OPPORTUNITY. You'll never get another such chance. This first allotment of 20,000 shares at $5 a share (par value $10 a share) will be snapped up so quickly that WE CONFIDENTLY EXPECT EVERY SHARE TO BE TAKEN UP WITHIN TEN DAYS from the publication of this announcement. After that, there will be no more $5 shares. The price will jump perhaps 40 or 50 per cent. SO ACT NOW.

Fill out the convenient coupon attached. Mail it with your first payment, which will RESERVE the stock you want at this LOW PRICE. Then you can take fifteen days to investigate, to make sure that all the facts are just exactly as represented to you. If you, for any reason whatever, are not satisfied, you can release your reservation and your money will be returned to you, but if you find out that you have invested wisely—as we are confident you will find out—then you can either pay the balance in full or you can take advantage of the easy method of paying for it, a little each month. Either plan is equally satisfactory to the directors of the National Rubber Company of New York.

IF YOU WANT ANY OF THIS UNDERWRITERS' STOCK, YOU'VE GOT TO WRITE NOW, at once, OR YOU WILL LOSE YOUR CHANCE.



The Magnificent Pottstown, Pa., Plant of the National Rubber Company, Where National Speedway Redwall Tires and National Red Tubes Are Made. Two Floors of This Big Building Are Completed and Occupied. This Is a Strictly Modern Steel, Concrete and Glass Construction Factory Building of the Highest Type. The Big Tire Coming Out of the Building Is the National Speedway Redwall Tire, Best on the Market.

How You Can Buy This Stock

10 shares (par value $100)

$10 down, $10 a month for 4 months.....$50

15 shares (par value $150)

$15 down, $15 a month for 4 months.....$75

20 shares (par value $200)

$20 down, $20 a month for 4 months.....$100

30 shares (par value $300)

$30 down, $30 a month for 4 months.....$150

40 shares (par value $400)

$40 down, $40 a month for 4 months.....$200

50 shares (par value $500)

$50 down, $50 a month for 4 months.....$250

$100 shares (par value $1,000)

$100 down, $100 a month for 4 months.....$500

APPLICATION FOR UNDERWRITERS' SHARES

E. E.

NATIONAL RUBBER COMPANY OF N. Y., Pottstown, Pa.
Main Office: National Rubber Bldg., Broad and North Sts.
PHILADELPHIA, PENNA.

Date.....191....

The undersigned hereby subscribes for.....shares of the Common Stock of the National Rubber Company of New York, full paid and non-assessable, and tenders herewith.....
(Bank Check or Money Order)

to the order of National Rubber Company of New York for $....., at the rate of $5.00 per share {full / part} payment.

STOCKHOLDER'S DISCOUNT—It is understood that in consideration of this subscription as long as I remain a shareholder of record on the books of the Company, I am to receive a Net Cash Discount of not less than twenty-five Per Cent (25 per cent) from the Company's regular Printed Price List, on any goods listed therein which I may buy for my own use. I am to have 15 days from date in which to investigate all statements made by the Company.

Issue shares in the name of..... and forward to addres below:
(Print Name Plainly)

(Subscriber's Signature) .....

(Street Address) .....(Town and State) .....

QUESTION BOX.

(*Continued from page* 130)

former, having a secondary potential of 10,000 volts. This to charge a group of four Murdock block condensers that will be connected in parallel. The discharge to take place in a quenched spark gap linked to a primary of an inductive oscillation transformer. The secondary to be connected in the usual way to the antenna and ground terminals. What I desire to know is what size of capacity of condenser is required to reduce the wave length of my oscillating system so as to conform to the Government's 200 meter wave length regulation? What formula do you employ in determining this capacity?

A. 2. The required formula is:

$$C_1 = \frac{\lambda^2 C}{3552\ L\ C - \lambda_1};$$

Where

C_1 is the capacity of the series ground condenser for reducing the wave length

λ_1 = wave length desired (here it is 200 meters)

C = Capacity of the antenna

L = Inductance of antenna

Having calculated the values of the capacity of the antenna .0004 mfd.; inductance 62,090 cm., we then determine the desired capacity by substituting in the above formula and we get:

$$C_1 = \frac{(200)^2 \times .0004}{3552 \times 62090 \times .0004 - (200)^2};$$

Solving, we get .003 micro-farad, the capacity of the condenser necessary to reduce the wave length of the antenna to 200 meters.

ELECTRON DISCHARGE.

(790.) Louis Bradenburg, Little Rock, Ark., wants to know:

Q. 1. Does the effect of light upon selenium crystal produce a purely electronic discharge?

A. 1. This question is still in the hands of some prominent physicists, and they have not come to any conclusions on this mysterious problem, and for this reason we are unable to give you an exact answer. We should recommend, however, that you read an article on selenium in this issue, written by two of the most prominent and able scientists on this subject.

Q. 2. I have had an idea for a number of years to make an electronic detector for converting high frequency currents to direct or pulsating currents, or in other words an instrument similar to the Fleming Valve and de Forest Audion. Now what I desire to know is, what chemical will produce an electronic field sufficiently strong for producing the same effect as that of the lighted filament? Also, was there any such device ever made?

A. 2. Dr. J. A. Fleming, the inventor of the Fleming Valve, has built electronic tubes employing an exhausted vessel in which an amalgam of Sodium and Potassium was placed in such a manner that it produced an electronic field when a beam of light was focussed upon its surface and in addition a secondary plate was placed within the focus of the electronic stream. The secondary and sodium-potassium plates were used for the rectifier circuit of the electronic tube.

The two most generally used of all the metals and alloys for the production of an electronic field are chemically pure and highly polished rubidium metal and an alloy composed equally of sodium and potassium metals.

TONE CIRCUIT.

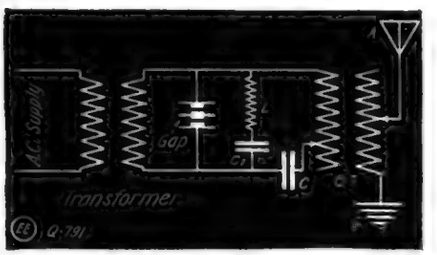
(791.) Roy Jansen, Houston, Tex., asks:

Q. 1. What does a "tone" circuit consist of and how is it connected to a radio transmitter?

A. 1. A tone circuit consists of nothing more than an oscillatory circuit shunted across the gap. This circuit is shown here and it is only used in an impulse exciting transmitter usually. The tone circuit is represented by the oscillatory circuit L C_1. A large capacity and a small inductance is used.

Q. 2. Is this circuit tunable? If so, how?

A. 2. The tone circuit is tuned to some multiple or sub-multiple of the impulse frequency. This is usually accomplished by varying the tone circuit condenser capacity. It should be kept in mind, that a tone circuit does not improve the tone emitted by the transmitter in every type of gap, as it was found by actual experiment that at times it is even detrimental to the tone. They are usually employed on low tension arc or spark transmitters such as the Von Lepel or Chaffee Arc.



Arrangement of Tone Circuit in the Von Lepel and Chaffee Arc Radio Transmitter.

MAGNETIC TELEPHONE.

(792.) William Olsen, Jamaica, L. I., desires to know:

Q. 1. What is the principle upon which two ordinary telephone receivers when connected together can transmit the human voice from one place to another by talking to the diafram of either of the two receivers?

A. 1. The principle of operation of such a telephone is identical to the production of electric current by a dynamo-electric machine, in that when a magnetic field is permitted to be interrupted by a wire near its field, a current of electricity is produced in that wire and the intensity of the generated current is dependent upon the rapidity with which the magnetic field is interrupted and the intensity of the field. It is identical with the magnetic telephone where the permanent magnet of the receiver furnishes the magnetic field, the coil of wire or electro-magnet represents the wire, while the interruption of the magnetic field is obtained in this case by the vibration of the magnetic diafram. When the diafram of the receiver is caused to vibrate by "talking," the magnetic flux is varied; generating a current in the coil which operated the distant receiver.

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☐ MINE FOREM'N OR ENG'R	☐ Railway Accountant
☐ Metallurgist or Prospector	☐ Commercial Law
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☐ PLUMBING AND HEATING	☐ Auto Repairing ☐ Spanish
☐ Sheet Metal Worker	☐ Navigation ☐ German
☐ Textile Overseer or Supt.	☐ AGRICULTURE ☐ French
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HIGH FREQUENCY PHENOMENA.

(793.) S. Kohn, Brooklyn, N. Y., asks:

Q. 1. Can you explain the following phenomena which I recently observed during certain experiments which I have carried on with a Tesla high frequency coil?

A large primary of a loose coupler was located near the Tesla coil; this was about 3 feet away from the same, and it was not connected to anything. As the Tesla transformer was set in operation, I have noticed streaks of sparks escaping the winding of the isolated coil. If it is possible, I should like you to enlighten me on this phenomena.

A. 1. The phenomena which you have observed is due to the striking resonance effect existing between the Tesla coil and the primary coil; since the resonance was pronounced, due to the effect noticed, the electrical energy transformation between the produced oscillations of the high frequency coil and that of the isolated coil is at maximum; consequently, the discharge of sparks from the coil was produced. These resonance high tension and frequency experiments were carried out first by Nikola Tesla, and he was able to obtain sparks which reached in magnitude from five to six feet in length.

TRANSFORMER FORMULA.

(794.) L. Kennedy, Los Angeles, Cal., wants to know:

Q. 1. In the design of a radio transformer, what are the most important precautions that must be taken in order to build an efficient transformer?

A. 1. There are a few important steps that the designer must observe when designing a transformer, namely: the voltage transformation between the primary and secondary, the latter should be made to correspond with the proper sending condenser capacity, and this must be obtained beforehand; the proper arrangement of secondary pies, separated with proper insulation, and finally, the magnetic circuit in which great care must be exercised in designing the same, as 75 per cent of the efficiency will be in this magnetic circuit. The proper number of cubic inches of core is at first found; this is then split up into suitable form, the legs of which should correspond to the primary and of the secondary windings.

Q. 2. What is the relation existing between the primary winding and voltage of a transformer?

A. 2. The relation of the two factors is exprest by the following formula:

$$N_p = \frac{10^8 \times E_p}{\sqrt{2\pi}\, f\, B\, A_c}$$

Where

N_p = Number of turns on primary winding
E_p = Voltage across primary
f = Frequency.
B = Magnetic flux of core (per sq. cm. of cross-section of the iron core)
A_c = Area (express in square centimeters of the cross-section of the iron core)

Q. 3. What do you consider the best insulation material for covering the core when the winding is to be made?

A. 3. Empire cloth is very excellent for this work and it is universally employed for this purpose.

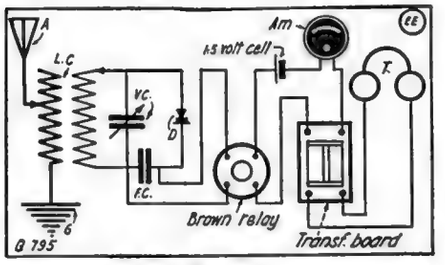
THE "BROWN" TELEPHONE RELAY.

(795.) Frank Vontair, Philadelphia, Pa., desires to know:

Q. 1. Is the "Brown" relay, which is used in England, a microphone device?

A. 1. This type of instrument is a

purely microphonic device and the microphone is controlled by a super-sensitive telephone relay. A more complete detail of this device was published in the August, 1915, issue of this journal.



Connection of the "Brown" Amplifying Relay in the Circuit of a Radio Receptor.

Q. 2. What is the binding post connections of this relay? How is it connected to a wireless receiving set?

A. 2. The accompanying diagram gives the connections.

Q. 3. Are these instruments used extensively in this country?

A. 3. No, they are mostly used abroad, especially in England.

MERCURY RECTIFIER.

(796.) Thomas Pierson, Richmond, Va., wants to know:

Q. 1. What is the efficiency of a mercury arc rectifier?

A. 1. The efficiency of this device varies with circumstances and depends largely upon the load voltage. There is a certain drop or lost voltage in the tube, usually 15 to 25 volts, which is practically independent of the load and the energy thus represented appears as light and heat. So if a set was delivering current at a potential of 15 to 25 volts, its efficiency under these conditions would be, roughly speaking, about 50 per cent. But this is rarely the case, and in most commercial installations of constant potential sets, the full-load efficiency is over 80 per cent and the efficiency of most constant current sets will be over 90 per cent at full load.

Q. 2. What is the life of a mercury rectifier tube?

A 2. The average life is about 700 hours, but many cases are known where the tubes have run much longer.

Q. 3. What is the power-factor of such a rectifying system?

A. 3. On a 50 light set the power-factor on the primary of the constant current transformer is about 65 per cent. On constant potential systems it may reach as high as 90 per cent.

MEASUREMENT OF IRREGULAR AREA.

(797.) Paul Andel, New Orleans, La., asks:

Q. 1. What are the principal methods for determining the area of an irregular plane surface such as those obtained from indicator cards, etc.?

A. 1. There are three general methods for obtaining the area value of irregular plane surfaces and the simplest of the three is by employing a "planimeter" instrument, a device which automatically figures out the area of the plane in question. Such an instrument consists of a wheel of definite circumference, which revolves when the lever attached to this wheel is caused to trace the perimeter of the irregular surface.

A second method is by forming a large number of small squares within the

(*Continued on page* 140)

BOOK REVIEW

THE SUBMARINE TORPEDO BOAT. By Allen Hoar. Cloth covers; size 8x5¾ inches; 212 pages, 84 illustrations and 4 folding plates. Price, $2.00. Publisht by D. Van Nostrand Co., New York City, 1916.

One of the most valuable and popular treatments of this all-important subject which is at the present time of interest to readers of all classes. Unlike a great many books of this nature dealing with such a specific and technical subject as the submarine torpedo boat, Mr. Hoar has given us a well-written and lucid description of this marvelous twentieth century war machine. The engineer and layman will both profit by perusing the interesting chapters of this authoritative writer, who is a junior member of the American Society of Civil Engineers. The various chapters take up the early history and development of the submarine torpedo boat, and contain some very interesting illustrations and photographs of practically every distinct type of submarine ever built. The succeeding chapters deal with the development of the present day submarine; its characteristics and requirements; types of submarines; the design of the submarine torpedo boat; the power plant; means of defense against submarine attack; tactical evolutions of the submarine; the torpedo; tenders and salvage ships; submarine mines, etc.

Some of the most interesting sections of the book deal with the approved manner of maneuvering a submarine in order to torpedo an enemy vessel, and also discuss authoritatively the various technical aspects developing in the general operation and handling of the submarine torpedo boat.

AMERICAN BOY'S BOOK OF ELECTRICITY. By Charles H. Seaver. Cloth covers; size 8x6 inches; 366 pages, 313 illustrations. Price, $1.50 net. Publisht by David McKay, Philadelphia, Pa.

The American boy is always interested in a good book treating on electrical experiments of a practical and interesting nature. There have been a great many books written in the past few years, intended for the electrically inclined youths of the land, but we do not remember seeing a more worthy volume in a long time than here presented by Mr. Seaver. The volume is profusely illustrated with clear-cut drawings, which can be readily understood by young boys of from ten to fourteen years, and all of the important fundamental magnetic and electrical laws with their accompanying actions and reactions have been cleverly and interestingly woven thru the experiments outlined.

A number of excellent half-tone illustrations are inserted, showing modern electrical appliances, so that as the boy studies the different experiments and simply explained laws, he will also be given a clear understanding of the relation between such experimental apparatus and the commercial instruments and appliances. Mr. Seaver is to be congratulated upon the adaptness with which he has combined these two important fields of electrical endeavor, so that the young reader will not become confused or discouraged by his inability to understand the underlying theory of the apparatus described.

The book describes how to build substantial experimental apparatus such as small dynamos and motors; induction or spark coils; telephone and telegraph apparatus; a complete wireless station of improved design; how to do simple house wiring in accordance with the standard rules; how to wire ignition circuits on gasoline engines of the single and multiple cylinder type; how to build small transformers and the principles upon which they operate; how to build primary and storage batteries; the action of lightning discharges and how to protect buildings from them, and also a considerable number of electrical experiments in static electricity. We strongly recommend this book to the American boy.

EXAMPLES IN ALTERNATING CURRENTS. Vol. 1, Second Edition. By Prof. F. E. Austin, B.S., E.E. Flexible green leather covers, pocket style; size 7½x5 inches; 224 pages, 75 illustrations with numerous tables. Price, $2.40. Publisht by the Author at Hanover, N.H.

The second edition of this valuable treatment of alternating-currents contains a number of ad-

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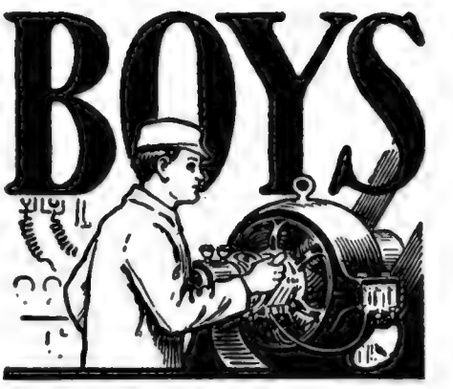

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☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
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☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROADER
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BOOKKEEPER
☐ MECHANICAL ENGINEER	☐ Stenographer and Typist
☐ Mechanical Draftsman	☐ Cert. Pub. Accountant
☐ Machine Shop Practice	☐ Railway Accountant
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ Common School Subjects
☐ MINE FOREM'N OR ENG'R	☐ CIVIL SERVICE
☐ Metallurgist or Prospector	☐ Railway Mail Clerk
☐ STATIONARY ENGINEER	☐ Textile Overseer or Supt.
☐ ARCHITECT	☐ AGRICULTURE ☐ Spanish
☐ Architectural Draftsman	☐ Navigator ☐ German
☐ PLUMBING AND HEATING	☐ Poultry Raising ☐ French
☐ Sheet Metal Worker	☐ Automobiles ☐ Italian

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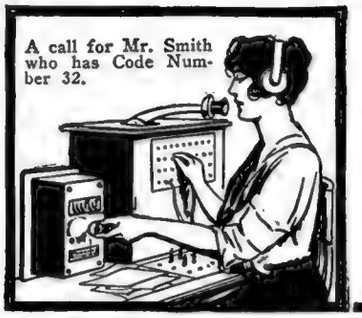

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The money saving answer to this problem is "Don't use the telephone at all to hunt men." Allow it to be used only *after* the man has been *found* by the aid of the National Calling System, which summons him instantly, no matter where he may be about your establishment or grounds. The man called then goes to the nearest telephone and talks directly with the man who sought him. No one's time is wasted, no one's work is disturbed.

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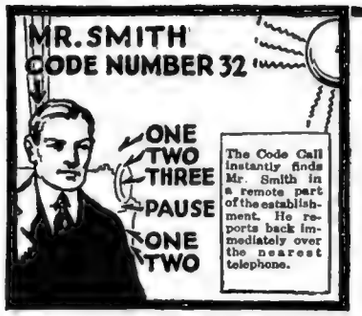


ditions and revisions, and will be found extremely valuable to all students of this subject. Some of the more practical examples given in alternating-current calculations involve frequency, power factor, harmonics, induced A.C. pressures, and the various specific values of A.C. potential, such as the instantaneous and effective values, etc., etc.

Many practical problems are explained by means of examples, and in accordance with the best modern methods, covering such topics as the addition of sine pressures; the product of sine curves having the same frequency but different phase displacements; the calculation and measurement of inductance coils, including the simple measurements of this important factor by means of a volt meter, ammeter and frequency meter, and including the new inductance formula due to Brooks and Turner. Further sections of the work treat on the inductance of transmission lines and various current and voltage relations, etc., when two or more impedances are connected in series or in parallel. Also the method of computing capacity of condensers, and the current taken by them when connected to A.C. circuits. The work concludes with a number of valuable tables containing the products of 2 x pi x frequency, and modifications of this expression, which are used so frequently in alternating-current computations.

How To Make Low Pressure Transformers. Third Edition, by Prof. F. E. Austin, B.S., E.E. Board covers; size 7¼x4¾ inches; 22 pages, 16 illustrations. Price 40 cents. Publisht by the author at Hanover, N.H.

Another addition of Prof. Austin's treatise on the design and construction of small, low-pressure transformers which has found considerable favor. The work takes up numerous practical operations to be followed in constructing step-down transformers for ringing bells, and for other operations, and also a design for a transformer giving as high as 174 volts when run on a 110 volt A.C. circuit. Data is given for these transformers for use also on 220 volts, 60 cycle A.C. circuit. The text matter is written in a clear manner which can be followed by any amateur and the illustrations are made in perspective so as to show explicitly just how the various iron core strips are assembled and clamped together, and also how the coil windings may be wound in sections to simplify the construction.

Applied Electricity For Practical Men. By Prof. Arthur J. Rowland. Cloth covers; size 5x7½ inches, 375 pages, 323 illustrations. Price, $2.00. Publisht by the McGraw-Hill Book Co., New York City.

This book has been prepared by an author of wide experience in teaching practically and theoretically the subject to students, and he has incorporated many valuable ideas in the matter presented. We believe this work should prove extremely valuable to electricians of all classes, as it contains all the fundamental electrical principles which are discust in an approved yet somewhat new manner, and gradually the student is introduced to the principles and practical operating features of dynamos; motors; electric heating apparatus; the wiring of switchboards and power plants; principles of the electric trolley system; alternating-current systems, including the various types of commercial transformers, and just how they operate and why; poly-phase current principles; alternating-current motors; storage batteries; electric circuits and wires and wiring.

Unlike many volumes of this nature, the author has seen fit to not only explain each subject in simple language at the start, but also to give the elementary formulas governing the theory and operation of these various electrical apparatus and circuits. The general electrical student will find this work of distinct value, and to enhance the value of each lesson he has studied, there are a number of questions and problems given at the end of each chapter which the student can work out.

The Science of Musical Sounds. By Prof. Dayton Clarence Miller, D.Sc. Cloth covers; size 8¾x6 inches, 286 pages, 187 illustrations. Price, $2.50. Publisht by the MacMillan Co., New York City, 1916.

This work by Prof. Miller treating on the science of musical sounds is one of the most pretentious science works that we have ever reviewed. A vast array of sound producing and analyzing apparatus of both simple and complicated structure are described and illustrated. The text matter is exceedingly clear, and can be readily understood by any student of music or physics. The author starts off with the definition of sound, and proceeds to give many illuminating details that the average physics student will find both new and interesting.

Every conceivable form of tuning fork and siren for producing sounds of any pitch or frequency is profusely illustrated and described. Among the subjects discust in a popular scientific manner, so that it may be enjoyed by the lay reader as well as the student of pure physics, are the action of organ pipes (including illustration of an organ pipe over 32 feet in length and giving sixteen vibrations per second), and such further practical considerations as standard tuning forks; the law of tone quality; the manometric capsule and revolving mirror, and also the use of the phonograph and Professor Miller's own invention, the "Phonodeik," by which apparatus it has become possible to intercept a sound wave such as a person's voice, and to project these, magnified many hundred times, upon a screen so that the voice fluctuations can be studied by a large body of students. The phonodeik is so remarkably sensitive to sound waves, that it will respond to a frequency of ten thousand complete vibrations per second.

The subject of harmonics has received special attention, and considerable discussion is given on the different types of harmonic analyzers, including the remarkable machine as used by the U.S. government for predicting the rise and fall of tides. Among other interesting subjects covered in this book, we find oscillogram curves of the voices of such famous singers as Signor Caruso and Amato. Also such an interesting subject as the influence of horns on sound, and the importance of diaframs in certain instruments. The principle of musical instruments, such as the piano, flute and violin are discust, and the music produced by them shown grafically by means of oscillogram curves. One of the most interesting chapters is that treating on synthetic vowels and words, and the relation of the art and science of music which is illustrated by many remarkable cuts of apparatus which have been developt for emitting vowel sounds.

A remarkable illustration is that showing the large group of organ pipes necessary, which when sounded simultaneously reproduce the vowel a, as in "mat," and still another illustration shows the vast number of organ pipes required to reproduce the principal vowels synthetically.

QUESTION BOX

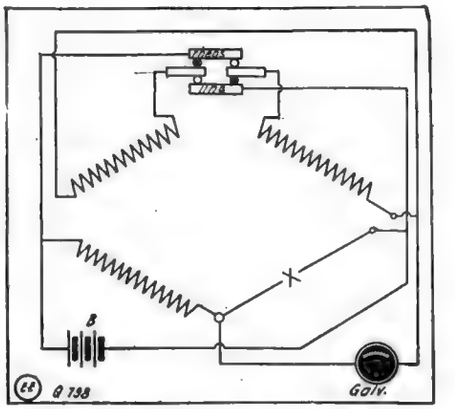
(*Continued from page* 139)

boundary of the plane surface, and determining the area of one of these squares, then multiplying the area of each by the total number of them within the surface. This will give an approximate area, since it is impossible to erect squares close enough to the irregular curves of the plane surface.

The third and most accurate method is by the use of higher mathematics: where a limiting value of the maximum and minimum peaks of the perimeter of the surface is obtained by actual measurement, and substituting this value in an integral equation as used in the Calculus. Some engineers weigh a sq. cm., or inch of the chart paper and then, by a simple calculation, compute the area of the irregular surface.

WHEATSTONE BRIDGE CIRCUIT.

(798.) John Brown, San Diego, Cal., wishes to know:



How a Reversing Key Is Connected In a Wheatstone Bridge.

Q. 1. How are the connections made of a Post Office type of Wheatstone bridge so that the resistance arms are reversed in the circuit? I understand this arrangement is used in eliminating errors in measurements which may be due to polarity interferences acted upon the galvanometer.

A. 1. The diagram herewith gives the proper connections of the instrument you mention. The reason for reversing the connections of resistance arms is to eliminate the errors produced by cross-currents in the circuit. By obtaining two sets of readings for both reversed positions of the arms, such errors are limited to a minimum.

ALUMINUM QUERIES.

(799.) Joseph Hassel, Boston, Mass., asks:

Q. 1. What are the ores used in the production of commercial aluminum?

A. 1. Aluminum oxid is the main source out of which aluminum is extracted. Bauxite, a hydrated oxid of aluminum, is extensively used.

Q. 2. How is the metallic aluminum obtained?

A. 2. The only process used at present for the extraction of aluminum is an electrolytic one. The electrolyte consists of a solution of aluminum oxid in melted cryolite. The cryolite is not decomposed, but serves as a solvent only. The mineral Bauxite is used to furnish the oxid. The cryolite is fused and kept liquid by the heat generated during the passage of the current; the dissolved aluminum oxid is separated into aluminum and oxygen by the current. The aluminum collects as a molten mass in the bottom of the melting pot; the oxygen is liberated at the anodes, which are oxydized by it. The weight of the anodes consumed about equals the weight of the aluminum liberated.

TELEVISION.

(800.) Thomas Jelinder, Hartford, Conn., asks:

Q. 1. Was television ever brought to a practical stage?

A. 1. No.

Q. 2. What method did Mr. Ernest Ruhmer of Berlin use for his television apparatus?

A. 2. He employed a large number of selenium cells placed before a similar number of lenses. Each of these cells corresponded to a "single eye," similar to the human eye, and the reflection of light from the object, the image of which was to be transmitted, was caused to fall upon the various selenium cells. These cells were connected to a corresponding number of electro-magnets which controlled a number of diaframs. These diaframs were set in operation in unison with their proper selenium cells at the transmitting station. A rectangular image was possible with this arrangement. It was used to transmit letters, as it was imperfect enough to be used to differentiate the actual colors of a photograph or image of a human countenance.

A number of suggestions have been made to develop a television scheme, but the inventors only went as far as making suggestions, but never went into the trouble of bringing out their ideas experimentally.

TRANS-PACIFIC RADIO COMMUNICATION SUSPENDED.

Wireless communication to Hawaiian territory beyond Honolulu has been suspended. Messages to other islands will be mailed from Honolulu.

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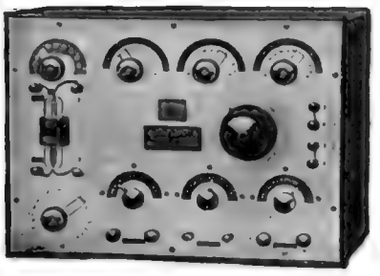

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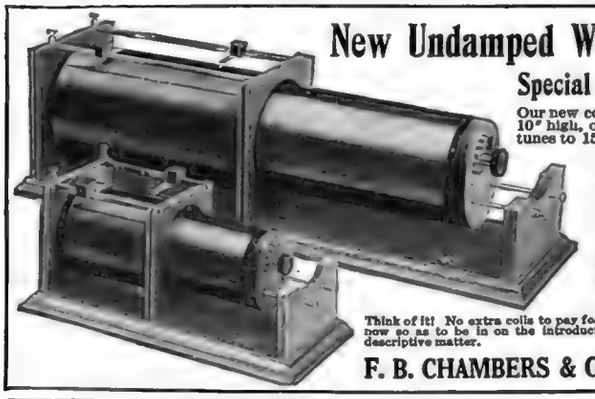

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CHANCES FOR ELECTRICIANS IN THE NAVY.

(*Continued from page* 86)

reciprocating steam engines, steam turbines, internal-combustion engines, magnetism and electricity, dynamos, motors, motor-generators, alternating currents, interior communication, lighting, batteries, etc. Members of the radio class are trained in all the duties of a radio operator and are given constant practice in the use of all the apparatus employed in radio and especially in receiving and sending by the systems employed in the Navy.

Enlistments in the Navy are for a period of four years. A man will not be advanced to chief electrician (with rank of chief petty officer) during his first enlistment, but he may be recommended for that position towards the completion of his first enlistment, with a view to advancement upon re-enlistment if any vacancy exists.

NEW METHOD OF MEASURING PRESSURE OF LIGHT.

(*Continued from page* 102)

The 32 c.p. lamp was enclosed in a metal box whose front face had been replaced by a glass screen covered with a few thin wires. Inasmuch as it is required that the radiation should be normally incident, the lamp was not brought too close to the tube, a calculation of the limiting approach having been previously made. The current passing thru the lamp was maintained at the same value thruout all the experiments. The reflecting and transmitting powers of the foils used were then tested. Gold and aluminum reflected 90 per cent of incident radiation.

Calculation of the Deflection of the Strip.—Since the foil reflects 90 per cent of the incident radiation, and since 7 per cent is reflected from the glass of the tube, the total pressure of the radiation is given by

$$E(1+0.07\times0.9)(1+0.9) \text{ or } 2.04E,$$

where E is the energy density of the incident beam.

A certain amount of radiation, however, strikes the back of the glass tube, and some of this is reflected to the back of the strip. For a strip three-quarters the width of the tube it is estimated that the normal component of this radiation is about 1 per cent of all that is incident on the strip. It is, therefore, necessary to substitute $2.02E$ for $2.04E$.

It can be shown that a uniform flexible strip when deflected by a small uniform pressure still remains straight. To a close degree of approximation, therefore, we may calculate the deflection of a strip such as that represented in Fig. 1 by taking moments about the axis of rotation. The details of apparatus used are given in the original paper, as well as the thermo-kinetic reaction and a table of results observed in succession.

ELECTROLYSIS SURVEY PROPOSED IN MONTGOMERY, ALA.

The Bureau of Standards has been asked to make an electrolysis survey in Montgomery, Ala.

DENVER WIRELESS STATION WINS PRIZE LOVING CUP.

(*Continued from page* 107)

the good times they used to have while working on the several relays which we have run for their benefit.

Next month we will start by giving some gossip about the famous *Washington's Birthday Relay,* and also give the first installment of a complete set of instructions about how to make a *Hall Wireless Relay,* as this instrument was shown in this magazine some time ago, under the list of patents issued; and as the writer has received a great number of inquiries concerning it, we believe that you will all be interested in reading about this instrument, which is very simple in construction, and which all of you may make, with just such tools and material as is always at hand in a radio laboratory.

The war will not last forever, Amateurs. Now is the time to make efficient instruments to be used after the war and to "brush up" on all Radio Matters.

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own a wireless station, either for sending or receiving? If you do, don't fail to join the greatest Wireless Association in the country: THE RADIO LEAGUE OF AMERICA. If you believe in the preparedness of your country, if you wish to help Uncle Sam, if you wish to have your station **officially** recognized, join the LEAGUE, a national, non-money-making organization. Beautiful engraved and sealed certificate, FREE to all members. NO DUES OR FEES WHATSOEVER.

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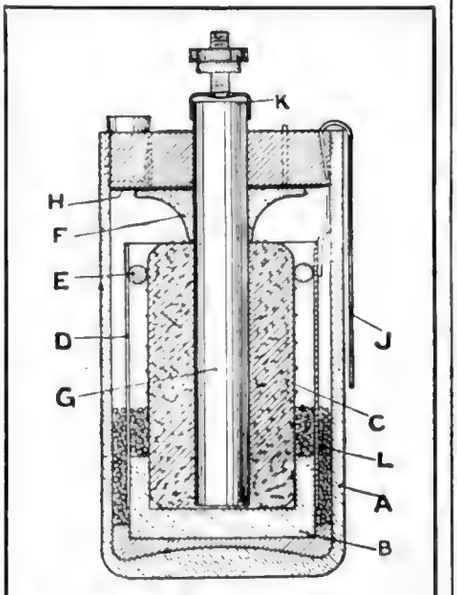
TO RECHARGE THIS CELL—FILL WITH WATER.

The "H_2O" Cell, as it is termed by its English sponsors, was introduced to meet



New English Type of Primary Cell Which Is Recharged by Simply Filling It With Water. It Is Known As the "H_2O" Cell.

the demand for a wet cell smaller and more compact than the "Leclanché," and in this respect it appears to have gained its advantage. This cell may be stored for any length of time and in any climate without any deterioration. It is not liable to creeping or evaporation while in use. Its internal resistance is low, and it does not polarize in use so quickly as wet batteries of the "Leclanché" type, it is claimed.

The addition of water only is needed for charging, and its active life is equal to any high-grade cell of similar size. If the cell is required for instant use, it is recommended that the cell be filled with warm water; distilled water being used, if possible, as this tends to prolong the life of the cell by reason of the absence of iron or lime impurities, which are frequently found in hydrant water.

In order that the condition of the zinc electrode and the interior parts of the cell may be examined, the container consists of

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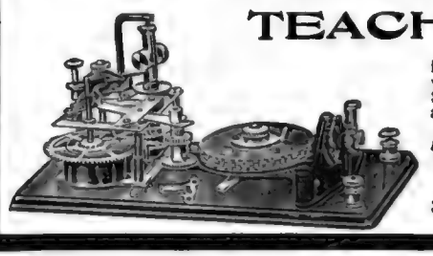

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a clear glass jar, A. (See diagram.) Into the bottom of this jar some bitumen is poured while in a hot condition. This serves to fix the porcelain base, B, in position. This base forms the support for the sack, C, keeping it in a central position, and also a support and spacer for the zinc cylinder, D, keeping it always the correct distance from the sack. It is this narrow space between the zinc and the sack which, to a large extent, makes the internal resistance of these cells so much less than Lechanché batteries. The top of the sack has a rubber ring, E, round it in order to further safeguard against the zinc cylinder touching the sack. Above the sack a specially shaped porcelain ring, F, is slipt over the carbon rod, G, and this serves as a support for a waxt cardboard disk, H, which supports the sealing compound. Two holes are arranged in the sealing compound and the cardboard washer; in one of these is a fiber tube. This tube forms the funnel thru which the water is poured when the cell is required for use, and is normally sealed with a cork. The other hole contains a small glass tube to allow the gases generated when the cell is in action to escape. A lead connection strip, J, is soldered to the zinc cylinder, and this is brought up at the side of the cardboard washer and thru the sealing compound. This lead strip is provided with a punched hole to allow of connection to an adjacent battery. A brass cap, K, is forced on to the carbon rod, and the nut for wire connections screws on to a pin riveted and soldered to the cap. The ammonium chlorid crystals, L, are placed in the cell at the time of manufacture; so that all that is necessary to make the cell ready for use is to remove the cork, fill the cell with water, and replace the cork.

POWERFUL HYDRO-ELECTRIC SALVAGE APPARATUS TO RAISE SUNKEN SHIPS.

(*Continued from page* 95)

may have gone ashore in shoal waters. Supposing that a vessel has become embedded in the sand. Upon arriving at the scene with one of the Linquist hydrostatic lifting units of the type already described, this is set up out in the deep water at a considerable distance, say one thousand to 1,500 feet from the vessel in distress, and a heavy cable is attached to the oceanward side of the vessel. In certain cases, and when necessary a line may be shot over the vessel to carry out this part of the operation. The cable which is secured to the stranded vessel is carried from the Linquist apparatus, and passes thru two large pulleys secured to a stationary truss on the base of the "fort," and in proximity to the vertical member of the lifting apparatus. The free end of the cable is secured to the top of the telescopic movable cylinder of the Linquist device, and this is made to rise by becoming more buoyant thru the agency of the electric pumps (supplied with electric power from the lines on shore), water being pumped out of the movable telescopic cylinder causing it to rise, and when this occurs a force of thousands of tons is brought into play, giving sufficient upward pull on the cable passing thru the stationary pulleys to haul the vessel off the shoal.

The inventor of this truly remarkable scheme for raising sunken boats, etc., says that if his device had been available at the time the U. S. Submarine F-4 sunk in the Honolulu harbor some time ago, that he could have raised the submarine in *four days* instead of taking four months, which was the time required by the only method available, when this deplorable accident

occurred. One of the divers who worked on the Submarine F-4 and who had negotiated depths of 306 feet (corresponding to a pressure of 135 pounds to the square inch) has seen the device and believes that Mr. Linquist's calculations as just cited are not only practical but feasible.

ELECTRICITY AND WATER TO RUN OUR AUTOS.

(*Continued from page* 88)

and air will eliminate all carbon deposits, and in so doing will add to the life and power of any motor, and that is not all, for we obtain our gas from water, which nature has provided abundantly, and so easy to secure that the cost is practically nothing.

Those interested in this electrolytic cell gas generator intended for a substitute for gasoline in driving automobiles will undoubtedly find interesting a U. S. patent on a similar cell, bearing the number 1,219,966 which is discust in the "Latest Patents" department on page 128 of this issue.

DECISION IN THE "HETERODYNE" RADIO RECEIVER CASE.

On April 2 Judge Mayer, of the United States District Court for the Southern District of New York, handed down an opinion in the suit of Samuel M. Kintner and Halsey M. Barrett, receivers of the National Electric Signaling Company, plaintiffs, vs. the Atlantic Communication Company, August Merckens, P. C. Schnitzler and K. G. Frank, defendants, in which he found for the plaintiffs. This suit was based upon a charge of infringement of United States letters patent 1,050,728 and 1,050,441, being respectively for the method and apparatus employed in a receiving station of a radio telegraph system. These patents, issued January 14, 1913, cover the invention known to the art generally as the "heterodyne" or beats method of receiving radio telegraph signals.

The court found that Reginald A. Fessenden, the inventor of this system, had produced an invention of great merit and entitled to a broad interpretation. He found that the prior art cited by the defendant as anticipating the Fessenden invention had failed to teach the art anything in respect to the use of beats and, at most, merely disclosed a local source for operating some particular form of receiver. He decided against the defendants' contention that the invention should be given a narrow construction, in view of an earlier patent of Fessenden.

The defendants' sole effort was directed towards securing a narrow construction of the patents. They contended that the Fessenden patents were not entitled to a broad interpretation but should be restricted to the use of the particular form of appliance shown in the issued patents. The court decided against this, holding the invention to be of such merit as to entitle it to a broad interpretation of equivalents.

The court also stated that Fessenden or his company, the National Electric Signaling Company, were the only ones to teach the art anything of value of this method of operation between the date of application of his original patent in 1902 and the date of applications for the patents in suit, 1905.

To overcome the difficulties of navigation in the Kara Sea the Russian Government has established three wireless stations that inform vessels of ice conditions.

A COMPACT FARM LIGHTING PLANT.

The farm lighting plant illustrated is rated at 1,000 watts and operates at 30 volts. In most cases a 2, 2½ or at most a 4-h.p. engine is required to run this system. The generator has a heavy flywheel pulley with tapered shaft.

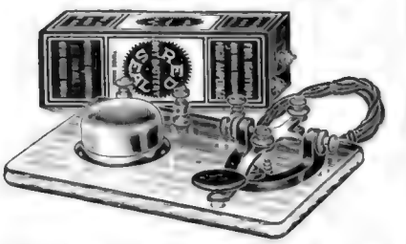
A feature of this equipment is that regardless of variation in the number of lights being used, the generator will automatically furnish the current necessary for these lights, in addition to that which it has already been furnishing for charging the battery, thus allowing the battery to receive its normal charging rate automatically, regardless of the number of lights being turned on and off. An automatic electric governing winding is incorporated in the design which prevents the variation in the lighting load from affecting the amount of current going into the battery. Lights may be used at any time either direct from the generator, if the engine is running, or direct from the battery, if the engine is not running.

The manufacturer also claims that by using this self-regulating winding for starting duty, engines, regardless of their type, can be started without abnormal strain on the battery plates. This condition applies specifically to engines of 8 h.p. or less. Twice the starting torque with one-half the current is said to be produced by means of this winding. In a test recently made, this unit, with an 80-ampere current, easily started a 4-h.p. special electric engine. A shunt wound generator failed to start the same engine with the ammeter reading 140 amperes. This plant permits the lights to burn at practically the same brilliancy at all times. If the lights are being used direct from the generator and should the engine stop, the electrical connections will be changed automatically, so that the lights will then receive their energy from the storage battery. The switchboard is equipt with large scale instruments, an automatic reverse current circuit breaker and only one lighting switch. All internal connections are made at the factory. The batteries used with this plant are made in both the Faure and Plante types, assembled in either rubber or glass jars.

A New Compact Electric Generating Plant Having the Switch-board Mounted Rigidly on the Dynamo Frame.

Mesco Wireless Practice Set

For Learning the Wireless Code



The Practice Set comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal Dry Battery, and four feet of green silk covered flexible cord.

The key and buzzer are mounted on a highly finished wood base, and three nickel plated binding posts are so connected that the set may be used for five different purposes, as illustrated on page 24.

For the beginner, the set is of exceptional value, for it may be used for individual code practice or for operation of a two party line, which is an excellent method of quickly learning the code. After the beginner has mastered the code, the set may be used in his wireless outfit for setting the detector in adjustment, and also the key may be used to control the spark coil.

Recommended for schools, as it gives excellent service for class instruction in code work. Full directions with each set.

The main object of the set is to enable the beginner to master the wireless code, and the buzzer reproduces the sound of the signals of the most modern wireless stations perfectly.

Every beginner needs one of these sets, and as it is the equivalent of five different sets, the price is very low.

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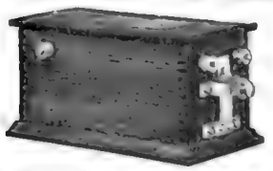

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SHIPS WHICH THE RADIO SAVED.

The U.S. Government cites the following marine disasters in which wireless figured during the period July 1 to December 31, 1916:

July 11.—Steamship *Ramos* foundered in a gale while en route from Philadelphia to Cartagena, Colombia. SOS calls were answered by the Miami land station and the steamships *Van Hogendorp* and *Illinois,* all but five persons on board being saved.

July 22.—Steamship *Matatua,* stranded on rocks seven miles south of St. Mary's Light, Cape Race. Vessel shot line to shore and passengers and crew were removed. The distress call was answered by the steamship *Stephano,* Red Cross Line, which stood by until passengers were safely removed.

September 15. — Steamship *Congress,* with 445 persons on board, caught fire off Coos Bay, Marshfield, Oreg. The vessel was headed toward shore. SOS calls being sent out continuously, which were received by the land stations at Marshfield, Oreg., Cape Blanco, Oreg., and Eureka, Cal., and the steamship *F. A. Kilburn.* Rescue vessels were dispatched by the Marshfield station, and all persons on board were saved.

September 23.—Steamship *Bay State* ran ashore off Cape Elizabeth, Me.; total loss. Distress calls were answered by the Coast Guard cutter *Ossipee* and the naval station at Cape Elizabeth, which dispatched the tugs *Portland* and *Cumberland.* All persons on board, approximately 200 in number, were saved.

October 7.—Steamship *Antilla,* with fifty-six persons aboard, caught fire off the Virginia Capes while en route from Guantanamo, Cuba, to New York. Approximately twenty-five vessels responded to the distress calls, and all persons were saved.

October 19.—Steamship *Araphoe* lost her rudder twenty-five miles north of Cape Lookout. SOS calls were answered by the steamship *Henry R. Mallory* and the Coast Guard cutters *Seminole* and *Tampa,* which towed the vessel to Norfolk.

October 28.—Steamship *Chicago,* with 265 passengers and crew, caught fire at sea and arrived safely at the Azores Islands. Communication was established with vessels, but assistance was not needed.

October 29.—Tug *Vigilant* disabled 150 miles off Irish coast. SOS call answered by the steamship *Ryndam,* which towed the tug to Queenstown.

November 25.—Steamship *Powhatan,* en route from Boston to Baltimore, caught fire off Block Island. Fire was controlled before arrival of Coast Guard cutters, which answered the distress call.

November 27.—Steamship *Niels Nielson* lost propeller in heavy gale. Distress calls were answered by several vessels, which assisted the disabled vessel to make port.

November 28.—Steamship *Coronado* lost propeller off Tillamook Head. Distress calls answered by Astoria, Oreg., station, which dispatched tug to assistance of disabled vessel.

December 3.—Steamship *Carolina,* Goodrich Transit Co., struck rocks off entrance to Sturgeon Bay Canal. Distress calls were received by the Manitowoc, Wis., station, which dispatched a tug to the assistance of the disabled vessel.

December 12.—Steamship *Sumner* grounded in fog off Barnegat, N.J. Six vessels responded to SOS calls, and all persons on board were saved.

December 14.—Steamship *Powhatan,* en route from Norfolk to Boston, sank in collision with unknown vessel on way to open sea. Several United States destroyers, Coast Guard cutters, and steamship *Jamestown* answered SOS calls. Crew transferred to Coast Guard vessels and passengers were taken to New York on the steamship *Jamestown.*

December 25. — Steamship *Maryland* sank at sea, position as given in SOS call 380 miles east of Sandy Hook, with crew of thirty-four. Distress calls answered by several Coast Guard cutters, but they were unable to locate the disabled vessel.

DO YOU?

By Albert W. Wilsdon.

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Apologies to "Casey Bee."

750,000 HORSEPOWER WASTED IN NEW YORK.

Electric power sufficient to turn every wheel and illuminate every dwelling and factory in New York State could be developed from the water power which is running to waste every day in the rivers, streams and canals of the State, Attorney General Woodbury declared in his annual report submitted to the State Legislature. He estimates a daily waste of 750,000 electric horsepower on the Long Sault Rapids and along the line of the barge canal. He urges the Legislature to establish a policy by which the State will reap some benefit from this stupendous resource, the value of which has been estimated by conservation experts at $250,000,000. Attorney General Woodbury points out that the Long Sault Rapids in the St. Lawrence River, control of which was recently regained by his office after a fight which was carried to the United States Supreme Court, could be harnessed to yield over 700,000 electric horsepower, while the dams and other structures along the course of the barge canal impound an excess of water over navigation requirements sufficient to generate 50,000 horsepower.

SPRAGUE DEFENDS ELECTRIC DRIVE FOR CRUISERS.

After consultation with Secretary of the Navy Daniels, Frank J. Sprague, Chairman of the Naval Consulting Board Committee on Electricity and Ship Construction, has come out strongly against the critics of electrical drive for the new battle cruisers.

In a letter to Senator Swanson, Chairman of the Senate Committee on Naval Affairs, Mr. Sprague says he has been reluctant hitherto to join in public discussion of the decision of the Navy Department to adopt electric drive.

"I feel that perhaps I am now justified in so doing," he adds, "in view of the fact that such discussion, which I assumed was begun from patriotic motives, seems to be taking on the nature of an active commercial propaganda, incidentally supported by a number of gentlemen, most of whom, however representative and endowed with experience along the lines of their individual professions, are utterly untrained in naval affairs, and hence are not possest of sufficient knowledge of this particular subject to indulge in the avalanche of criticisms which have been leveled at the department."

Referring to what he describes as "the successful installation of the electric drive on a comparatively small scale on the collier *Jupiter* and the adoption of similar power for three battleships," Mr. Sprague reminds Chairman Swanson that "the Navy Department, reinforced in their opinion by what had been done in electrical development in great power plants, decided upon electric drive also for the battle cruisers, each of which is to be equipt with engines of the large total of 180,000 horsepower.

"The wisdom of this decision," Mr. Sprague continues, "was challenged by Charles Curtis of the International Curtis Marine Turbine Company, which company would, if geared turbines were adopted instead of the electric drive, be a beneficiary by a large amount of royalties. It is, of course, difficult for one engaged in a commercial enterprise which may be seriously affected to be, even if unconsciously so unaffected in his judgment by personal interests, but I prefer to believe that Mr. Curtis was actuated by a desire that our cruisers should be the best afloat, even if I disagree somewhat with his methods and conclusions.

"Failing to get a reconsideration of the Navy Department's decision, a number of prominent engineers have been requested to write, and several have written, letters based on certain adverse information supplied them, some condemning without reserve the decision of the department and others urging that the matter be referred to the Naval Consulting Board or some other board of civilian engineers.

"Among those other than Mr. Curtis, who have been quoted as authorities are Dr. S. S. Wheeler, President of the Crocker-Wheeler Company, manufacturers of electrical machinery, who has been voluminous in his criticisms; Dr. Francis Crocker, an associate of Dr. Wheeler; George Gibbs, Consulting Engineer of the Pennsylvania Railroad; Dr. Michael Pupin, a distinguished scientist and inventor of a system for increasing the efficiency of the long-distance telephone; Isham Randolph, a well-known civil and railroad engineer; Prof. William H. Burr, a widely-known consulting engineer; President Falk of the Allis-Chalmers Company,

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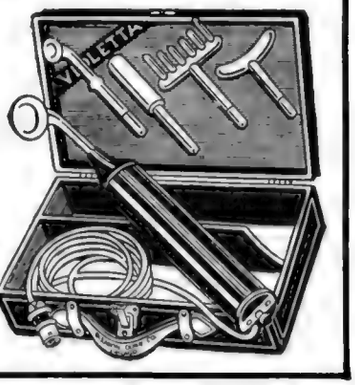

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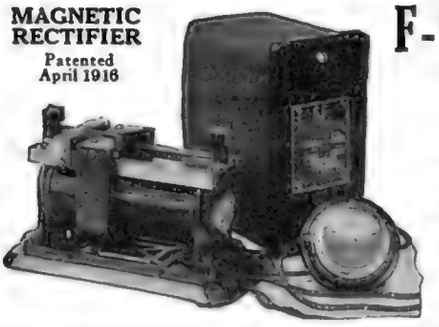

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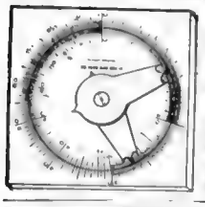

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manufacturers of electrical machinery; Luther Lovekin, Chief Engineer of the New York Shipbuilding Company, and Calvin Tomkins, former Dock Commissioner of New York."

Observing that this list "contains many names not only of men of prominence but of men standing high in their professions," Mr. Sprague says: "But the question may properly be asked to what extent are these gentlemen qualified to criticise, what is the training and experience which would warrant them to sit as judges in so vital a matter, and what is it they really seek to accomplish.

"The discussion," Mr. Sprague continues, "seems first to seek to condemn the adoption of electricity on the score of increased weight and cost, or impossibility of construction, or safety in operation, and second, a reference of the whole matter to the Naval Consulting or some other board.

"It is inconceivable," says Mr. Sprague, "that with all the known facts in hand the Navy department would or could surrender to outside advisers, directly or even inferentially, the selection between two known and accepted methods of drive, with their varying influence upon the distribution of weights, location of turrets and armor, size and disposition of compartments and the results of flooding, the distribution of fuel, the distances of machinery from the skin of the ship, provision against torpedo damage, the necessities of handling ships in emergencies and the results of failure of any parts."

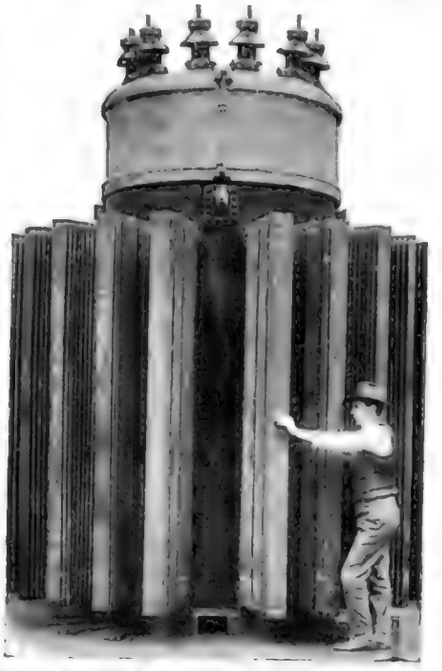
Mr. Sprague declares that generators and motors of the size indicated can be built, and that if necessary they can even be controlled by a push button from the bridge.

"I am," he says, "generally credited with being the pioneer of the modern electric railway and am certainly the creator of that system of train control, now used the world over, which makes it possible to aggregate any amount of power required under a single control."

One reason why Mr. Sprague was selected for the Naval Consulting Board was that he had served as President of four technical societies—the American Institute of Electrical Engineers, the American Institute of Consulting Engineers, the New York Electrical Society and the Inventors' Guild.

A PRESENT-DAY ELECTRIC GIANT.

While we may not have the human giants of old with us, their places are admirably filled by the gigantic mechanical and electrical apparatus that modern genius has evolved, as for instance, the device shown in the accompanying illustration. This picture shows the largest self-control induction, feeder voltage regulator that has ever been built. The regulator is of the oil-insulated, self-cooling type, and was built by a Pittsburgh concern. It is rated at 600 kva. (kilowatts) 3-phase, 60 cycles, 13,200 volts, with 10 and 20 per cent regulation at 262 and 131 amperes. It is designed for operation outdoors with full-automatic control self-contained.



The Largest Self-control Induction, Feeder Voltage Regulator Ever Built.

This regulator was built for the Southern Power Company and is to be connected to the low voltage side of a 6000 kva. (kilowatt) bank of 44,000 to 13,000 volt transformers on the power company's line at Spray, N. C. By the use of this regulator the power from the line will be delivered to the Thread Mill Company mills owned by the Marshall-Field's interests, with the voltage maintained continuously at normal value.

JOHN J. CARTY, TELEPHONE ENGINEER, NOW MAJOR CARTY.

Mr. J. J. Carty, chief engineer of the American Telephone and Telegraph Company, New York City, and recognized as one of the foremost authorities in the world on wire communication, has been commissioned senior major of the Signal Officers' Reserve Corps, the reserve auxiliary of the Signal Corps, U. S. A. The addition of Mr. Carty to that organization will be a decided accession and one which will be widely applauded. It is believed other appointments will follow from the ranks of leading American engineers. The importance of the telephone system in any plan of national defense has been accepted by officials of the War Department.

The adaptability of the American telephone lines was thoroly proven last summer when the entire A. T. & T. Company's service was turned over to the Government for a test under hypothetical war conditions. In 45 seconds Secretary Daniels was in communication with the Pensacola, Fla., Navy Yard, and in 28 seconds more was talking with the navy yard at San Diego. The Secretary of the Navy later exprest his pleasure over the "wonderful success" of the experiment. When the country's National Guard was mobilized last summer a complete telephone exchange was established at Camp Whitman, in New York State, in less than 24 hours after the troops were called out, connecting Washington with Albany, N. Y., and all the vital points necessary to the movement. The commissioning of Mr. Carty as an officer in the Reserve Corps may be taken as a further step to have this important branch of the country's defensive system ready, not only in material, but in personnel.

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PATENT ADVICE

Edited by H. GERNSBACK

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

BELL SOFTENER.

(152) E. T. Jones, New Orleans, La., writes as follows:

"I, a subscriber to your wonderful magazine, would greatly appreciate your opinion on the following 'phone-attachment, printing same in your Patent Advice department in one of the following issues this year, as soon as possible.

"After reading over your article on patents wanted, I devised a scheme by which any tone desired can be had instead of using bells. I have drilled and tapt the armature knob of the ringer and screwed thereon a certain device; on a protruding stand, I have a mandolin string, which is adjustable (any note can be had); when the 'phone (rings) the device passes over the string and I have attained a dull, soft-pitcht tone which is audible three rooms away.

"I would appreciate your opinion on the above arrangement, and I highly recommend more suggestions on your part in a magazine which I and a million or so others cannot do without, as it is the *only live one* out to-day. I read it from cover to the last page and find old copies interesting even after they have been fully read."

Ans. The idea, while a very good one, does not seem very practical for the reason that the device would take up too much room. If an arrangement were obtained whereby the long string could be done away with, we think a more practical arrangement would be had, but we believe a patent can be obtained on the idea.

INVISIBLE PERISCOPE.

(153) Jose M. Moreira, Lowell, Mass., submits a design of a *glass* periscope, his idea being to make it invisible.

Ans. While this is a good idea on paper it does not work out in practise for two reasons, one of which is that glass is too dangerous a substance to be used for a periscope which has to stand enormous strains due to rushing thru the water as it speeds on. Furthermore a periscope sticking out of the water can never be invisible, that is, while the periscope itself may not be seen at a distance, it forms a white *wake* as it runs in the water, which is very noticeable. It is not the periscope itself that the enemy will see, but the water trail which the periscope leaves behind. As long as nothing is found to do away with this wake, it is useless to make the periscope itself invisible.

AUTOMATIC TUBE CLOSER.

(154) James D. Miller, Montreal, Quebec, Canada, submits to us several drawings of collapsible tubes such as are used with tooth-paste and shaving creams, the idea being to do away with the annoyance of unscrewing and screwing on the cap which so often exasperates us.

Ans. The drawings submitted to us of the device are very ingenious indeed and hold out a possibility of a good invention. We, however, would advise our correspondent to simplify the idea, as at present it seems too complicated, having too many parts. We would also advise our correspondent to submit the idea to a patent attorney with a view to obtaining copies of prior patents on this particular class of work.

INTERRUPTER.

(155) Geo. Shaw, Talmage, Neb., has conceived an idea for the improvement of interrupters for small wireless sets and other outfits requiring the use of a small transformer or spark coil. The idea is to use a certain form of interrupter in an air-tight chamber, under sufficient air pressure to prevent the burning of the contacts. He thinks that a small hand air pump could be secured to the chamber to pump up sufficient pressure. Is the idea a good one and is it patentable, and would there be a demand for it?

Ans. A scheme of this sort is decidedly not satisfactory because it has been shown that comprest air will retard an ordinary vibrator spring or, for that matter, any moving part which is supposed to operate under high speed. If instead of using comprest air you use a vacuum, enormously better results are obtained, as, for instance, in the Moore *Vacuum Interrupter*. Personally, we have no faith in comprest air interrupters, as we have never seen one work satisfactorily.

ELECTRIC CIGAR MOISTENER.

(156) Charles Bicker, Salina, Kans., says that he has an idea in the construction of a device to moisten cigars and tobacco in show cases. The idea is to make steam by heat developed from storage batteries, and to evaporize the steam in a certain manner.

Ans. While a patent might be obtained on a scheme of this kind, we do not know how valuable it will be without knowing full details. There are some very good and cheap electric tobacco moisteners on

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the market to-day and we have one in mind which seems to have the greatest sale, whereby an electric incandescent lamp is plunged in a basin filled with water, which owing to the heat of the lamp, is made to evaporate.

AMPLIFICATION TRANSFORMER.

(157) A. J. Camile, New York, N.Y., sends in a sketch and description of a transformer which is supposed to amplify alternating current ten times or more without any other means. He proposes in a sketch and description, that it will transform 110 volts 2 amperes into a current of 110 volts *31 amperes!*

Ans. No matter what a scheme of this kind may consist of, it is absolutely impossible. You cannot obtain energy for nothing and you might just as well try to lift yourself by your own boot straps. It simply cannot be done.

PATENT ATTORNEYS.

(158) Edmund von Szuppiny, Paterson, N.J., writes as follows:

"Wishing to find out thru whose services Edison, Maxim, or Lewis obtained their patents, I sent for the literature of a good many patent attorneys.

"Many of them list a considerable number of names and addresses of their clients who, however, are almost all unknown to the world at large, and no matter how I tried, I failed to find the names of Tesla, Hammond, etc., in any one of their lists.

"This makes the impression upon me that inventors of this magnitude do not care to intrust their inventions to the advertising patent attorneys.

"Will you kindly inform me what means or what agencies this—say Edison or Tesla—uses when wishing to patent one of their inventions."

Ans. The answer is a simple one indeed. We have good reasons to believe that several of the greatest inventors of this country patronize the advertising patent attorneys, but they usually restrict attorneys from using their name for obvious reasons, as it is naturally to their interest not to disclose who does their work for them. Personally, we think you will get cheaper and better service from advertising patent attorneys than from those who do not advertise, for the simple reason, that the former do a larger business and consequently can work cheaper. The quality of a patent obtained certainly does not make a lot of difference whether it is turned out by an advertising attorney or by one that does not advertise.

The editor, who is the owner of some eighteen patents, might state that nearly all of these were obtained from advertising patent attorneys.

TOY ELECTRIC HAMMER.

(159) R. DeWitt Duffield, Van Wert, Ohio, has submitted to us a simple design of a toy electric hammer and wants to know if such an article is on the market already and if it is worth while patenting.

Ans. This indeed is a very excellent idea and one of the best schemes for a cheap electric toy that we have seen lately. While there is nothing particularly new in the principle, we are certain that a patent may be obtained on the construction of same.

Our correspondent also submits to us a sketch of an electrolytic interrupter on which he desires our advice.

Ans. Nothing new is shown in this design, and similar interrupters are in use all over the world and a patent can certainly not be obtained on this device.

JOE'S EXPERIMENT.

(*Continued from page* 101)

forming the circle which surrounded the erect and alert chief, his pale face drawn and anxious as he eyed the watch he held in one hand.

"Do you think they'll stand it?" he asked in husky, worried tones.

"Sure, there isn't much load on," Pete Foley assured him.

It was just a minute before twelve. The generators below were purring smoothly, filling the whole building with a vibrant, steady hum.

Five seconds past — ten — twenty — the group grew silent, watching the chief, Mr. Robertson, as he squared himself in front of the main control panel. Twenty-five seconds past—thirty—forty.

At ten seconds before twelve Mr. Robertson reached for the push-button in the center of the panel marked, "Main Switch."

His hand rested on the metal disc for a moment and then as the watch held in his left hand marked five seconds before twelve, he prest the button.

There was a purr of mechanism behind the marble panel as the big main switch fell into place. The generators dipt a note or two in their hum, and then rallied as more water came thru on their turbines. The group watched the voltmeter on the panel anxiously, and as the seconds past and it did not waver, Mr. Robertson heaved a great sigh of relief and satisfaction.

"It works! It works!" he shouted, in sudden released exuberance. "They've got their power and we've got our franchise."

A white-linened, diamond-pinned director reached for the chief's hand.

"Don't congratulate me," Mr. Robertson hastened to forestall him. "We're saved because some one thought of a very simple expedient. Here, I'll show you."

He stept to a panel at his right, followed by the interested group. He paused before a rheostat, glittering in bright metal. From its connections two wires led down to a coil of wire on the floor.

"This coil," he said, indicating it, "is a resistance coil. It is connected in series with the field windings of the exciter. In this way the voltage of the exciter has been lowered, thereby reducing the strength of the alternator's field, which in turn lowers the voltage of the machine itself. As a result we have the voltage of the high tension line lowered to such a point that we are sending current directly into the Merwin service lines without any intervening step-down transformer. A very clever and simple expedient, which will work until the transformers arrive. And so I congratulate the man who suggested it to me, Mr. Peter Fo——"

"No, you don't. Not me," Pete interrupted, as Mr. Robertson turned to him. "Here's the boy you want to thank. He saved your plant and not me," and he pushed forward Joe Benson from the shelter of the post where he had been standing.

"He told me about this trick and asked me to tell you. So just give him the thanks and the reward," Pete went on, eyeing in triumph the astonished faces of the group about him.

"It wasn't much. Any electrical man could have thought of it," Joe said modestly, blushing happily in sudden confusion. "And anyhow I couldn't have done it, if Pete hadn't showed me things so well the day I was here looking around."

"Yes, that was the day he was in the way," Pete said, with a significant glance toward Mr. Robertson.

But the chief had recovered from his surprise and had stept forward to the blind

(*Continued on page* 152)

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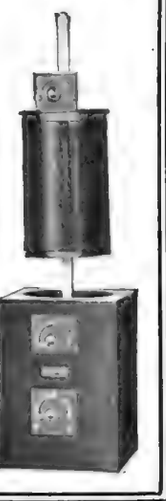

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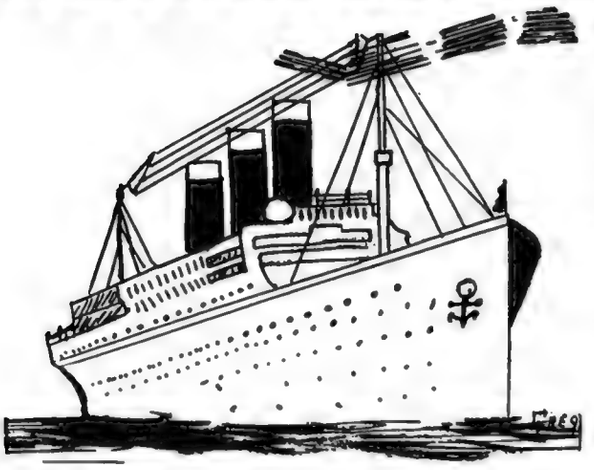

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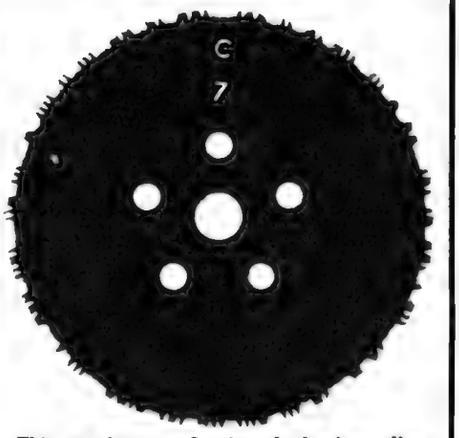

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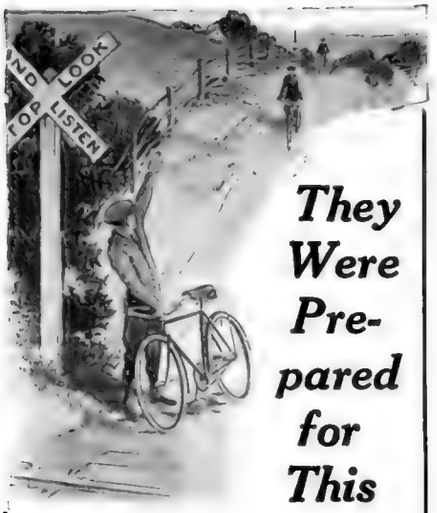

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Deninger, The Price Cutter, Rochester, New York

JOE'S EXPERIMENT.

(*Continued from page* 150)

boy, before the circle of directors could close in on him.

"Shake," he cried, gripping his hand. "Any boy who can think of a thing like that deserves a chance to learn more, whether he can see or not. So if the company doesn't out of gratitude, I'll see to it myself that you go to the best technical school in the country."

ELECTRICITY AND LIFE.

(*Continued from page* 105)

culosis and other pulmonary troubles often yield to the "effleuve" treatment.

3. Perhaps the most remarkable therapeutic effect of heavy high-frequency currents is their power to liberate heat in the tissues of the body. For this purpose the so-called "D'Arsonval current" is used. This is a secondary current of high amperage derived from the heavy coil of copper strip shown in Fig. 6. The lower terminal of this coil is connected with the condenser pad on which the patient is seated; the tubular metal electrode is held in both hands and connected thru a Milliamperemeter with the upper turns of the coil. The clip is moved to different turns as in wireless tuning, until the meter shows the highest reading for a given amount of exciting current. The patient's circuit is in this way tuned in perfect resonance with the primary oscillations. After a few moments the patient's wrists become hot, the heat rapidly extending up the arms and into the body until profuse perspiration is produced. Ordinarily we do not carry the treatment as far as this: the safe dose for an average patient being not over 700 milliamperes for twenty minutes. This is "D'Arsonval Autocondensation", and is applied with great benefit to patients suffering with *Arteriosclerosis* ("hardening of the arteries"), and in a variety of other diseased conditions involving malnutrition.

4. In diseases in which we wish to induce a regenerative inflammation, promote circulation and absorption, and increase cell activity, the method known as "Diathermie" is employed. Instead of the hand electrode and condenser-pad the D'Arsonval current is applied thru two small sheets of block-tin about 2 x 4 inches. These are applied to the skin on either side of the affected part and a current employed which gives the patient a decided sensation of penetrating heat. Average treatments use from 1000 to 1600 milliamperes. In treating consumption (pulmonary tuberculosis) one electrode is placed on the back and the other on the chest over the affected lung. One Tuberculosis Hospital in which this treatment was given daily to a number of patients reported 85 *per cent of cures!* The author is working on an apparatus which will make possible the use of Diathermic treatment in the homes of patients suffering from this disease.

For office use and for the Electro-medical specialist ("Electrotherapeutist") the writer has recently designed an apparatus from which remarkable results are being obtained (see Fig. 6). The Tesla and D'Arsonval coils are excited by a wireless transmitting set of the well-known "Hy-tone" type. The *rotary quenched gap* with its exceedingly high-spark frequency produces an almost sustained wave in the High-frequency coils. Both for the Tesla and D'Arsonval treatment the writer believes this apparatus superior to any that he has used up to the present time. The vitalizing and exhilarating effects are extremely pronounced. The machine has the added advantage that there is no troublesome spark gap to adjust, the strength of the current being regulated by a many-stept rheostat in the primary transformer circuit.

Much has been done in adapting high-frequency currents to the treatment of disease, but much remains yet to be done before we shall be able to avail ourselves of the wonderful healing and vitalizing powers which these currents undoubtedly possess. The writer hopes to be able to continue his studies along this line, believing that when we can scientifically apply to our patients *pure undamped waves* of definite form, frequency, amperage and voltage, we will obtain results far surpassing anything that we have dreamed of up to the present time, and that in the future the scientific use of high-frequency currents will become the greatest method ever discovered for the healing of disease, the promotion of health and the maintenance of a *"More Abundant Life!"*

EXPERIMENTAL PHYSICS.

(*Continued from page* 106)

goes out solidly, so that now our siphon has its "arms" filled and acts the same as the ordinary siphon.

EXPERIMENT 28—The following is an interesting and amusing experiment. It can be made to appear mysterious, and is important because in it lies the principle of the submarine. In Fig. 24-A, 3 is a jar or other cylindrical glass vessel about two-thirds full of water. 2, is a small, light glass bottle, or better, a small glass vial. 1, is a piece of sheet rubber stretched over the top of the jar. Before placing 1 in position, vial 2 is partly filled with water and inverted so that it just floats upright. On pushing down on the sheet rubber the vial (Cartesian diver) sinks and on releasing it rises again. When we push down on the sheet rubber, we compress the air in the jar and hence it forces more water into the vial. Since it was originally adjusted so that it just floated, the addition of more water into the vial makes it heavier and hence it sinks. On releasing the sheet rubber the pressure in the jar becomes normal again, and hence the pressure in the vial causes the excess water to come out and the vial returns to its original position. Fig. 24-B, shows a more mystifying form of the same experiment. 3, is a Florence flask, while 2, is the same vial adjusted exactly as in Fig. 24-A. 1, is an ordinary cork stopper. After the vial is adjusted, the stopper is put in carefully. (It may be necessary to adjust the vial so that it floats *almost upright* so that on pushing in the stopper, a little more water enters the vial and it just floats upright.) On holding the flask in the hand it is found that one can, by squeezing it, compress the air and make the diver perform. Thus one can make the diver obey one's command to rise or sink, without the audience perceiving the cause. Obviously a thin flask which will yield to squeezing is necessary for this experiment and the ordinary Florence flask answers the purpose very well. The real submarine boat is so constructed that no water can enter it, even if it is wholly submerged, except at the will of the occupants. It is able to float like any other ship just as our vial can float. If the occupants wish the boat to submerge, water is allowed to enter into special compartments until the weight of the boat slightly exceeds the weight of

the water it displaces. When they wish to rise again, some of this water is forced out.

EXPERIMENT 29—We are all familiar with the fact that objects weigh less in water than in air and that some things float in water. No one who has ever taken a bath has failed to notice this, and as a matter of fact the great *Archimedes,* who first formulated the *law of buoyancy,* first noticed the buoyant effect of water while taking his daily or yearly bath (I do not know which). If a block of wood, a piece of stone or marble, or a brick and a piece of cork of the same size and shape are weighed in air, they are found to have different weights. If then each is weighed in water (see Fig. 25-A) they are again found to weigh differently but they all weigh less, and as a matter of fact it is noticed that the LOSS IN WEIGHT is in each case the same, except in the case of the cork which floats and does not weigh anything. If next we fill a can until it nearly overflows and immerse one of our objects (except the cork) in it, and catch the overflow water in another can and weigh it (subtracting the weight of the can), we find that *the weight of the water displaced is equal to the weight lost when the bodies were immersed* in the first part of the experiment. In Fig. 25-B, abcd, represents the cross-section of the body used. The pressure at ad, is equal to the weight of the column, eoad. The pressure at cb, is equal to the weight of the column, ceob. The difference between the two is the resulting buoyant force at cb, and is equal to the weight of a column of water adcb, which of course is the amount of water displaced. The cork being lighter than water, if it were immersed the buoyant force would be greater than its weight and therefore it is forced to the surface. Hence the cork will sink only until enough water is displaced so that the buoyant force equals its weight, *i.e., only part of it will sink.* The ordinary ship floats because it is constructed so that if it were immersed, the buoyant force would be greater than its weight.

(*To be continued*)

THE NAVAL RADIO OPERATOR.

(*Continued from page* 109)

Members of the Electrical Class are quartered on the receiving ship at either Mare Island or New York. The school buildings are situated in the Navy Yard. Outside of the regular school hours a course of instruction is contemplated whereby they will be instructed in the regular duties of a man-o'-war's-man; this is necessary, as every man aboard ship, irrespective of rating, is a member of a military organization. Shore leave is granted in accordance with the regular Navy custom, usually from 4:30 p. m. to 7:30 a. m. every other day. Leave of absence is granted after completion of course.

The course at the Electrical School comprises twenty-two weeks of advance work and three weeks of examination. The schedule of marking is based on 4 as perfect and a final average of 2.8 is necessary in order to obtain the rating of electrician upon graduation. Each man is assigned a mark upon daily oral recitations and weekly written examinations. The final examination is in writing. In the radio course the greatest emphasis is placed upon the ability to send and receive the Morse and Continental codes, also radio regulations.

OUTLINE OF THE RADIO COURSE.

The outline of the radio course is as follows:

Machine Shop (bench work).
Magnetism and Electricity.
Alternating Currents.
A. C. and D. C. Instruments.
Batteries.
Motors and Motor Control.
Radio Power Circuits.
Primary Circuits.
Secondary Circuits.
Condensers and Oscillating Currents.
Radiating Currents.
Transmitting Sets.
Receiving Circuits.
Receiving Sets.
Service Radio Sets and Routine.
Wave Meters and Measurements.
Radio Regulations and Fleet Work.
Radio License Booth.
Review and Examination.

To the above course is added several weeks of practical work and special details. Students enter the Electrical School at any time and commence the course on the Monday following their date of entrance. Each week corresponds to a class or grade and shows the subject which the student is studying, and the lapse of time since entrance to the school.

The first eight weeks of the radio course are devoted to subjects pertaining chiefly to general electricity and serve as the ground work for the study of radio. Text books used in the first eight weeks are "Swoope's Lessons in Practical Electricity" and "Bullard's Naval Electricians' Text Book."

Both the Continental and Morse codes are taught. Two operating tables, each with a capacity of twenty men, are fitted with head 'phones, sounders, and transmitting keys. The instructors are Chief Radio Electricians. Each instructor is assigned an operating desk having control over a certain number of tables. The students are assigned to tables according to skill in receiving and are advanced to faster tables whenever necessary. Final examinations are held after the completion of the twenty-second week. The average operating ability of the students completing the course is 25 words per minute. A great many of the students, however, approach a speed of 30 words per minute.

It is believed that men completing the radio course at the Electrical Class successfully have obtained an excellent general knowledge of radio and have fitted themselves for rapid and sure promotion in this branch of the Naval service.

THE HOW AND WHY OF RADIO APPARATUS.

(*Continued from page* 113)

chanical pressure can be exerted axially upon them, in order to make the gaps thoroly air tight. For outputs above one-half K.W., the gap often becomes unduly heated, and it is common practise to place a small motor-driven blower or fan beside the gap, in order to cool it by carrying off heat from the cooling flanges.

At Fig. 4, we have what is known as a *rotary-quenched* spark gap. This particular design of gap has met with considerable favor, especially for small radio transmitters, of from one-quarter to several kilowatts output. This gap possesses the distinct and remarkable quality of producing a high-tone in the telephones at the receiving station, even tho it is used on a low frequency or 60 cycle transformer at the transmitting station.

In the first place, this gap operates with a remarkably small clearance between its two semi-circular fixt spark electrodes and its rotary electrode, or having a gap about

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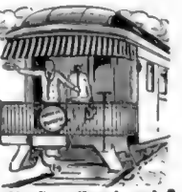

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three-thousandths of an inch in length. The gap operates in an air-tight chamber formed by a heavy metallic casting, which carries suitable cooling vanes, and besides which there are provided a number of auxiliary cooling vanes as shown in Fig. 4, at the rear of the gap. Being air-tight at the start, this gap operates in the same manner as the design shown in Fig. 3, known as the Telefunken gap. To obtain a high spark note with the rotary quenched gap of Fig. 4, the two fixt and also the rotary electrodes have their faces accurately machined or milled-out at equal distances, resulting in a number of teeth, between which the spark occurs. These gaps have to be built very accurately of course, as the gap itself measures about .003 inch, and it is desirable to have the sparking distances constant and similar. A typical gap of this class has the sparking surfaces and the copper on both stationary and rotary elements milled with thirty-six radial slots, so that when rotated by a small motor at 1,800 R.P.M., the resultant tone corresponds to that of a 540-cycle alternator. It is necessary that the width of the spark segments are so proportioned that sparks will occur during not more than one-half of the total time, as otherwise the telephone diafram at the receiving station is retarded in its excursion away from the magnet, thereby resulting in a decrease in the sound intensity.

[*Those interested in this spark gap will do well to look up the matter in the excellent paper by Mr. Melville Eastham, entitled "The High Tone Radio Telegraph Transmitter" in the December, 1914, issue of the proceedings of the Institute of Radio Engineers.—Editorial Note.*]

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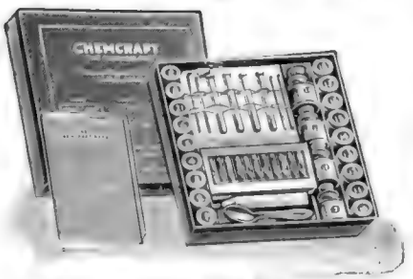

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(*Continued from page* 117)

so rapid that it will not produce an audible sound in the receivers, so that the discharge of an Oudin coil cannot be used for the transmission of wireless messages, altho who can say, if it is properly conducted to the aerial, that it does not travel as far or farther, than an undamped wave.

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EXPERIMENTAL CHEMISTRY.

(*Continued from page* 127)

be left in a closet, or some place else for a week, or until the water has disappeared. The reaction for this experiment is:

$$\underset{\text{Copper}}{3Cu} + \underset{\substack{\text{Nitric}\\\text{Acid}}}{8HNO_3} = \underset{\substack{\text{Copper}\\\text{Nitrat}}}{3Cu[NO_3]_2} + \underset{\text{Water}}{4H_2O} + \underset{\substack{\text{Nitrogen}\\\text{Monoxid}}}{2NO}$$

MADE FROM ACIDS AND SALTS.

EXPERIMENT NO. 61—

Put 5 or 10 grams of marble chips into a wide test tube and add about 10 cc. of dilute Nitric acid, [HNO_3] [half acid and half water]. Apply the splint test by applying a lighted splint to the mouth of the test tube, after the action has progrest for a short time. After the action has stopt, and if not clear, filter, and evaporate most of it.

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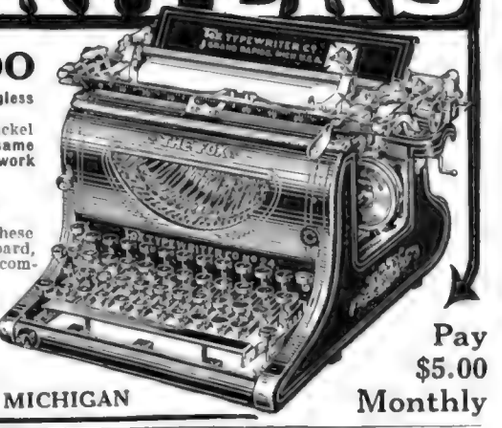

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EXPERIMENT NO. 62—

Put 2 or 3 grams of Ferrous sulfid [FeS] in a test tube and cover it with water. Place this near an open window, or in a place where a draft of air can be created to carry away the escaping fumes. Add 5 cc. of Hydrochloric acid [HCl] [keeping in a draft of air]. When the action stops, filter and evaporate. Equation:—

$$\underset{\text{Ferrous Sulfid}}{FeS} + \underset{\text{Hydrochloric Acid}}{2HCl} = \underset{\text{Ferrous Chlorid}}{FeCl_2} + \underset{\text{Hydrogen Sulfid}}{H_2S}$$

EXPERIMENT NO. 63—

Put 10 grams of fine salt [Sodium Chlorid] [NaCl] in a large test tube, and add 10 cc. of concentrated Sulfuric acid [H_2SO_4]. Carry on this experiment near a window or where a draft of air can be created. Heat the solution over a Bunsen burner very cautiously, and moderately. After the action has progrest for 5 or 10 minutes let the tube cool, then pour in 15 or 20 cc. of water, to dilute or dissolve the solution. If the liquid is not clear, filter it, and evaporate the filtrat [the liquid which passes thru the filter paper]. If concentrated sulfuric acid is present, it will destroy the filter paper.

Equation:—

$$\underset{\text{Sodium Chlorid}}{2NaCl} + \underset{\text{Sulfuric Acid}}{H_2SO_4} = \underset{\text{Sodium Sulfate}}{Na_2SO_4} + \underset{\text{Hydrochloric Acid}}{2HCl}$$

Soluble and Insoluble Substances.

All the common acids are soluble. Some of the bases are soluble, some insoluble. An insoluble substance is one which does not dissolve, or which dissolves very slightly in water. Besides water there are many other solvents, as, alcohol, chloroform, ether, carbon disulfid, and the various alkalis, and acids, and unless a certain solvent is mentioned, water is the one referred to. To be able to distinguish clearly between soluble and insoluble substances, is the basis of chemical analysis.

Soluble salts, are usually prepared by [1] neutralization, as in experiments 54, 55 and 56; [2] by the action of an acid on a metal, as in experiments 58, 59 and 60; [3] by the action of an acid on a salt, as in experiments 61, 62, 63.

In experiments 54, 55 and 56, we prepared a soluble salt by Neutralization. Upon making a mixture of the acid and base [in solution] a reaction took place and a salt was formed. As a salt usually gives a neutral reaction, a point is reached, in the mixing, if it is done very carefully, at which the whole mixture was neutral to litmus. If the solvent water was evaporated at this point, the salt should be obtained as a solid, which in some cases may break up owing to excessive heat.

In experiments 58, 59 and 60, we prepared a soluble salt by dissolving a metal by an acid. The result which we obtained is called a chemical solution and consists of two stages; [1] the metal combined with the negative part of the acid, and formed a salt; [2] the salt dissolved in the liquid, the larger part of which is water. Thus it is clear why a salt which is insoluble in water is not usually made in this manner.

In experiments 61, 62 and 63, we made a soluble salt by the action of an acid on other salts or compounds. Metallic oxids, carbonats, and sulfids are the most common of these. Suppose we wish to make some calcium chlorid [$CaCl_2$]. We know that it is soluble, and suppose that Hydrochloric acid [HCl] will probably dissolve the calcium. But we also learn that calcium is not a common metal in the laboratory, so we look for an inexpensive compound upon which the Hydrochloric acid will act. The carbonat [$CaCO_3$, limestone, or marble], is plentiful, and hydrochloric acid attacks it with great vigor. The reaction would be:

$$\underset{\substack{\text{Calcium Carbonat}\\\text{[Limestone, or Marble]}}}{CaCO_3} + \underset{\text{Hydrochloric Acid}}{2HCl} = \underset{\text{Calcium Chlorid}}{CaCl_2} + \underset{\text{Water}}{H_2O} + \underset{\text{Carbon Dioxid}}{CO_2}$$

Insoluble substances, salts and bases, are prepared in the laboratory almost wholly by one process, *Precipitation*. An insoluble salt or base may be made by mixing two solutions, one of which contains a compound of the metal, the other a compound of the non-metallic part of the insoluble salt, which will appear in the mixture as a precipitat. Lead sulfat [$PbSO_4$] is made by pouring a solution of lead nitrat [$Pb[NO_3]_2$] upon a solution of Sodium sulfat [Na_2SO_4] .

$$\underset{\text{Lead Nitrat}}{Pb[NO_3]_2} + \underset{\text{Sodium Sulfate}}{Na_2SO_4} = \underset{\substack{\text{Lead Sulfate}\\\text{[precipitats]}}}{PbSO_4} + \underset{\substack{\text{Sodium}\\\text{Nitrat}}}{2NaNO_3}$$

Acids are usually made by acting with a less volatile acid, as Sulfuric acid [H_2SO_4], on a salt of the acid required. We have seen that salts can be made by the union of an acid and a base, and we now learn that an acid can be obtained from its representative salt. Sulfuric acid is generally used, for making acid, because it is one of the less volatile acids, and thus it readily parts with its hydrogen and takes a metal in its place. A salt of the acid desired must be put with the sulfuric acid; for example, if Hydrochloric acid [HCl] is wanted, Sodium chlorid [NaCl] or some chlorid is used. If Nitric acid [HNO_3] some nitrat, as Potassium Nitrat [KNO_3], should be used.

Soluble bases, especially the alkalis, may be made by acting with calcium hydroxid on certain salts of the base required. Other bases, for example Sodium or Potassium Hydroxid, may be used in place of Calcium hydroxid. Ammonium hydroxid [NH_4OH] is prepared from a salt of Ammonium, as, Ammonium Chlorid [NH_4Cl], Ammonium Nitrat [NH_4NO_3], Ammonium Sulfat [$NH_4]_2SO_4$, etc., by heating it with a mixture of calcium hydroxid [$Ca[OH]_2$] [slaked lime].

$$\underset{\text{Ammonium Chlorid}}{2NH_4Cl} + \underset{\substack{\text{Calcium Hydroxid}\\\text{[Slaked lime]}}}{Ca[OH]_2} = \underset{\text{Calcium Chlorid}}{CaCl_2} + \underset{\text{Ammonium Hydroxid}}{2NH_4OH}$$

Sodium hydroxid is made from Sodium Carbonat [Na_2CO_3] and Calcium Hydroxid.

Insoluble bases are made by mixing two solutions, one of which contains a base and the other a compound of the metal of the base required. Ferric Hydroxid [$Fe[OH]_3$] can be prepared by adding Sodium hydroxid solution to a solution of Ferric chlorid [$FeCl_3$]. Any other soluble ferric [but not ferrous] salt would do as well, and any other soluble hydroxid. Ferrous hydroxid [$Fe[OH]_2$] requires a soluble ferrous [not ferric] salt.

SOLUTION:—

In Experiment 5 [August, 1916, issue of THE ELECTRICAL EXPERIMENTER] we illustrated *Solution* by experiment. We found that by dissolving the sugar in water, we formed a *Solution*. Sugar is said to be Soluble in water, and the water is termed the *Solvent*. The sugar is the *Solute*. A substance is said to be in solution in a given liquid, when it is evenly distributed thruout the liquid in such fine division that its particles cannot be seen, and which do not settle or precipitate upon standing.

The most important property of water is its ability to dissolve a large number of substances. Liquids which do not separate but form a uniform mixture when

(*Continued on page* 156)

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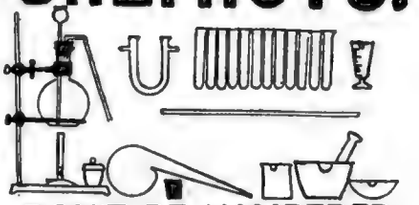

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brought together, such as alcohol and water, or glycerine and water, are said to be *Miscible.*

An insoluble solid, like starch-powder or clay, can be dispersed thru water by shaking, but the mixture will be *Turbid* like muddy water. A turbid mixture of a solid and liquid is called a *Suspension.* In time the suspended matter will settle, leaving the liquid clear. Dissolved matter will never settle.

SOLUBILITY FACTORS:—

The *solubility* of most substances is decidedly affected by the temperature. Solids are usually, but not always more soluble in liquids at high than at low temperature. In Experiment 5, we found that sugar was more soluble in hot water than in cold. Calcium Hydroxid, used in the preparation of limewater, is more soluble in cold water than in warm water.

The solubility of gases decreases as the temperature rises. Ammonia and Carbon dioxid are less soluble in hot water than they are in cold water. Different substances vary very much in their solubility in a given solvent, and different solvents differ in their power to dissolve the same substances.

SATURATION:—

If a small portion of salt is dissolved in a large quantity of water, such a solution is then said to be *Dilute.* The substance is uniformly distributed in all parts of the liquid in a dilute solution, as it is in one containing a much larger proportion of the dissolved substance.

By slowly adding salt to a measured volume of water, it can be shown that there is a limit to the quantity which the water will dissolve. One liter of water at 20° C. will take up any quantity of salt up to 360 grams, and no more.

At this point the solution is said to be *Saturated;* or in other words, the water has dissolved all the salt it can under given conditions. If any more salt is thrown into such a solution it will simply fall to the bottom and form a layer which, no matter how thick, *does not increase the amount dissolved.*

EXPERIMENT NO. 64—

Take 100 cc. of water and saturate it with sugar at 20°. It will take up 200 grams. Now heat the liquid to 100° and dissolve more sugar in it. It would probably take up 300 grams additional, but only add about 20 grams. Allow the liquid to again cool to 20°. This solution must be allowed to cool *without any disturbance* and *kept perfectly quiet* in a clean bottle; the separation of the extra 20 grams of sugar may not occur for a long time. This liquid contains more sugar than the saturated solution contains, at the same temperature, and when in such a condition is said to be a *Super-saturated Solution.*

Drop a crystal of sugar into the above super-saturated solution, and if the experiment has been performed correctly, this crystal will precipitate, or throw down, the extra 20 grams of sugar in crystals, and the saturated solution will be formed.

DELIQUESCENCE:—

If Potassium Carbonat is exposed to the air, it absorbs the moisture from it, becomes damp, and finally forms a solution. This, if substances absorb sufficient moisture to dissolve them, or become wet, the name *deliquescence* is applied to this behavior, and the substances are said to be *Deliquescent.* Substances which so absorb moisture from the air are also said to be *Hygroscopic.*

EFFLORESCENCE:—

This term should not be confused with *Effervescence,* which is the escape of a gas from a liquid in which it is either generated or has been held by pressure.

If a crystal of washing soda is exposed to the air in a dry place, it will lose its water of crystallization and become covered with a fine powder. This is called *Efflorescence.* Copper Sulfat [Bluestone $CuSO_4 5H_2O$], retains its water in ordinary air but in very dry air it turns white and *Effloresces* rapidly.

CRYSTALLIZATION:—

When a saturated liquid is cooled and the solid precipitates, the latter is quite likely to form crystals, especially if the cooling is slow. Evaporating the liquid from a saturated solution precipitates the solid, often in crystalline form. These are crystals from solution. They may also be obtained from *Fusion, i.e.,* melting a crystalline substance and allowing it to cool slowly. Another method of obtaining crystals is to make an insoluble compound in the usual way, by mixing two solutions. Generally precipitates obtained in this way are *Amorphous* or *indistinctly* crystalline, as time is not given for the forces of crystallization to arrange the molecules in crystalline form. Crystals may also be obtained by the sublimation from a vapor. Some substances do not crystallize at all and are termed *Amorphous,* meaning without crystalline form.

EXPERIMENT NO. 65—

Fill an evaporating dish half full of water, heat it [using asbestos pad on tripod or ring stand support], and add to it alum, either powdered or in small pieces, until the liquid shows a tendency to become thick. Stir it, and remove the flame, and stretch across the dish a narrow piece of calico or cotton cloth so that the middle portion will hang in the solution. Set aside to cool. It may be well to allow to stand a week before examining. This experiment illustrates crystallization from a supersaturated solution.

EXPERIMENT NO. 66—

Cautiously boil about 5 grams of copper sulfat [$CuSO_4$], pulverized, in 10 cc. of water in a test tube until it is dissolved. Then place the test tube in an oblique position and let the liquid cool. It should be allowed to stand for some time. The crystals obtained can be dried between filter or blotting paper and preserved. This experiment illustrates *crystallization from solution.*

EXPERIMENT NO. 67—

Melt 15 or 20 grams of brimstone (Roll Sulfur) in a short, wide test tube. Cover its mouth now and then with cardboard if the sulfur should take fire. After complete *fusion* let it stand still till it starts to solidify on the surface; then pour off half of it into a dish of water and set the rest aside to cool. Examine the part in the water, pulling it to note its elasticity, etc. When the part left in the tube is solid, break the tube and look for crystals.

EXPERIMENT NO. 68—

Put 3 or 4 crystals of Iodine into a wide, perfectly dry test tube. Have a dry stirring rod in the right hand, and with the left hand, hold the tube containing the Iodine in the flame of the Bunsen burner. As soon as dense purple fumes begin to rise in the tube, remove the tube from the flame, and thrust the stirring rod into the tube, nearly to the bottom, being careful not to touch the sides of the tube with the rod. Keep it there until the Iodine vapor has settled, and examine both the rod and tube by means of a lens. This experiment is the same as Experiment 12 [ELECTRICAL EXPERIMENTER, September, 1916, issue], and illustrates the formation of crystals by *sublimation.*

EXPERIMENT NO. 69—

Place a piece of Ferrous Sulfat [$FeSO_4 5H_2O$], in some place where it may be exposed on a piece of paper for a week or so, after which time examine for white powder. This experiment illustrates *Efflorescence.*

EXPERIMENT NO. 70—

Expose a piece of Calcium Chlorid [$CaCl_2$] on a paper for a week or more. Note any phenomena. This illustrates *Deliquescence.*

The laws of precipitation state:—

[1] That when two substances are mixed in solution, a new compound can be formed that is insoluble in the solvent employed, such compound will be formed and will appear as a *precipitate.*

[2] When, on mixing different substances, a new substance that is volative can be produced by the rearrangement of the atoms of the partaking substances, such new substance will be produced and will appear as a *gas.*

EXPERIMENT NO. 71—

Suppose we wish to prepare Silver Chlorid [AgCl]. We know that this compound is insoluble. Therefore we must select a soluble salt of silver, and also a soluble chlorid. Silver Nitrat [$AgNO_3$] being the only soluble silver salt in common use, we make a solution of it. We may also take most any chlorid, because they are mostly all soluble. Sodium Chlorid [common table salt] being one of the cheapest, we shall use it. Take a little Sodium Chlorid and dissolve it in water. Pour one of the solutions into the tube containing the other, and the precipitat of silver chlorid which we wanted is thus obtained. Save the precipitat for the next experiment. This experiment also illustrates a substance which is insoluble in water.

EXPERIMENT NO. 72—

Prepare some Silver Chlorid [AgCl] as in Experiment 71, taking not over 5 cc. of each solution and using for one the silver salt prepared. Let the Silver Chlorid subside and pour off the upper supernatant portion of the liquid, leaving the solid with some liquid. Add a little Ammonium Hydroxid [NH_4OH], cover the mouth of the tube with the thumb, and shake well. If the solid does not all disappear, add more Ammonium Hydroxid. Upon the addition of Ammonium Hydroxid, the precipitat should be dissolved and a clear translucent solution formed. Thus we have *prepared a solid from two clear liquids,* and *then dissolved the solid with another liquid.* This experiment shows that substances which are insoluble in water, are made soluble in various other liquids.

(*To be continued.*)

Statement of the Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, of The Electrical Experimenter, published monthly at New York, N. Y., for April 1, 1917.

State of New York, County of New York, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Hugo Gernsback, who having been duly sworn according to law, deposes and says that he is the Editor of The Electrical Experimenter and that the following is to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, The Experimenter Publishing Co., Inc., 233 Fulton St., New York City; Editor, Hugo Gernsback, 233 Fulton St., New York City.; Managing Editor, Hugo Gernsback, 233 Fulton St., New York City; Business Manager, Hugo Gernsback, 233 Fulton St., New York City.

2. That the owners are: The Experimenter Publishing Co., Inc., 233 Fulton St., New York City; Hugo Gernsback, 233 Fulton St., New York City; S. Gernsback, 233 Fulton St., New York City; Mrs. K. Hymes, 233 Fulton St., New York City; H. W. Secor, 233 Fulton St., New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is .....

(This information is required from daily publications only.)

H. GERNSBACK, Editor.

Sworn to and subscribed before me this 16th day of April, 1917.

(Seal.) E. D. JUNIOR.

(My commission expires March 30, 1919.)

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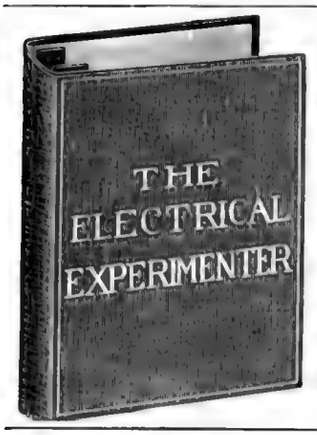

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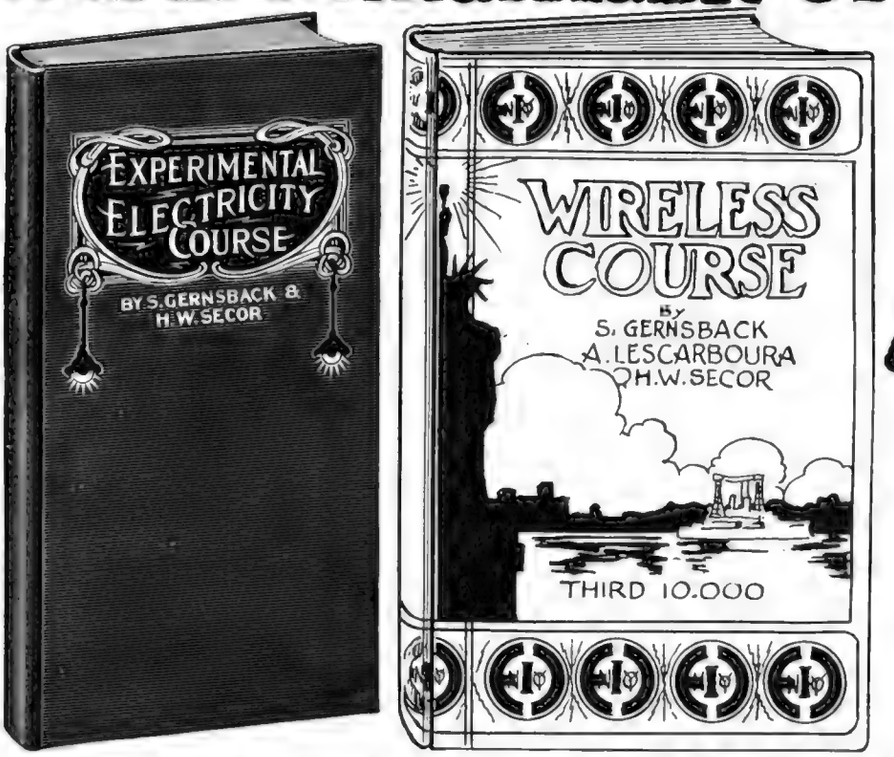

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WANTED—Tents, Scouting and Gym supplies. Have Wireless Instruments to swap. Dean Wilson, Alpha, Ill.

FOR SALE—Receiving Set, consists Arlington Coupler, H-C 3000 ohm Phones, Murdock Condenser, Perikon Detector, Switches and large quantity Crystals. All new. Only $14. J. Smith, Trout Run, Pa.

FOR SALE—One Junior Cyclecar at $65. A bargain. Jacob Rau, Bathgate, N. D.

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WANTED—Trade foot-power lathe, Post drill, 25-20 Mailin pump rifle for wireless goods. Write for particulars and state what you have to sell or trade. Lee Jones, 706 Lillmore, Amaillo, Texas.

FOR SALE—Amateur receiving set, good condition. Write Dock Stuart, Troy, N. C.

WANTED—Battery Rotary 2-inch Spark Coil, for instruments I have. Write for list. August Otta, Moweaqua, Ill.

WANTED—Omnigraph and dials. Also "Smith" Flyer or motor wheel. Must be cheap. Cash only. E. Wilson, Gwynedd Valley, Pa.

FOR SALE—Two 3¼x5½ film cameras. Ansco, $10; Eastman, $6. Smith Premier Typewriter, $15. Automobile magneto, $5. Dynamomotor, $1.50. Lawrence Johnston, Fairfield, Ill.

QUICK—FOR SALE—Oscillation transformer, regenerative set, navy type coupler, audion panel, storage battery. Extremely low prices. Lester Fawcett, Independence, Iowa.

AUDION and Amplifier cabinet set, including tuning equipment, $50. Audion detector broken bulb, $8. Want Blitzen coupler; pair undamped coupler coils, $2.50. McMurdo Silver, 264 West 57th St., New York City.

FOR SALE—¼ H.P. 2 Cycle Engine, $12. 12 volt 8 ampere generator, $8; physicians microscope, Bausch and Lomb make, $20; cost $65. B. Roehling, 3705 N. Hermitage Ave., Chicago, Ill.

FOR SALE—A first-class violin and bow (less bridge and strings) A-1 condition. Cost $20, sell for $15. Marcus Harbs, Wilton, Conn.

OMNIGRAPH WANTED—Will pay cash for Omnigraph in first-class condition. B. Cochran, Box 55, Palmetto, Georgia.

FOR SALE—200 watt transformer. Steps 110 to 10, 20, 30 or 40 volts, $10; 40 watt dynamo or 1/12 H.P. motor, $7; Inch spark coil; fine fat spark, $4; Testing magneto, $2.50; 20 ohm sensitive pony relay, $1.50; 20 ohm giant sounder and steel key, $2.50; Portable Voltmeter, 1-20 range, $1.50; Filings coherer, $1; 75 ohm wireless receiver with headband, $1.25; 1/12 H.P. water motor, $1.50. C. M. Adams, Milford, Ohio.

SELL—40 lesson Taxidermy Course, $9. Trade 3 yrs. Youth's Companions for A1, 2 slide tuner. William Litwiller, Hopedale, Ill.

FOR SALE—Silicon Detector without cat whisker wire, 50c; 1,000 ohm Receiver, 75c; Galvanometer, 25c; Telegraph Set, 50c; Leather-covered headband, 50c. Remittance must accompany order. Write Harry Layman, Davidsville, Pa.

UKULELE—Koa wood, $10, or trade for camera. Give size, lens, style, make, etc., or guitar. Clyde B. Marx, Kaskela, Oregon.

FOR SALE—Otis Clapp Static Machine in first-class condition. Two 19" plates on hand operated end. Ten 29" plates on power operated end. Several Leyden jars and various discharging devices to go with machine. Cabinet measures 66"x66"x30" wide. All enclosed in glass, $75, f.o.b. Mattapan, Mass. Cost $450. Fritz Henrici, Mattapan, Mass.

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BARGAINS—Leaving home, must sell. New Electron Relay, $3; slightly used, $2. Loose Coupler, $1. 500 volt D. C. 1/3 horsepower Holtzer Cabot motor and rheostat equal to new, $15. D. P. 1,000 ohm phone, headband, cord, $1.25. Electrolytic detector, 75c. Telephone magnetos, solid armature, 50c, laminated, $1. $10 Remy 6 volt automobile magneto, good condition, $3. Six-inch parabolic reflector, 50c; new bulbs, 20c. High resistance ringer coils, 15c each; telephone transmitters, 50c; receivers, 50c; induction coils, 20c; ½ lb. 22 German Silver wire, 35c; 2 lb. antenium wire, 40c; quantity 2 strand steel guy wire cheap. Premo Junior No. 2 Camera, new, $1. Mechanical, electrical magazines cheap. Prepaid except magnetos, motor, wire. Stamps or money order, or write for further information. Kenneth Bard, Manawa, Wis.

EXCHANGE—Complete set of parts for a Ford engine, with exception of crank shaft and flywheel for a panel type receiving set, typewriter or wireless supplies. J. Yates Van Antwerp, 35 South Perry St., Johnstown, N. Y.

SALE OR EXCHANGE—B-Flat cornet, $12; shotgun, $3; incubator, $3. John Enos, Wellfleet, Mass.

FOR SALE—1½ H.P. Gas Engine, 500 watt 110 volt D.C. Generator, small lathe, ⅛ H.P. 110 volt D.C. motor, Jeweler's Foot Wheel. Write for description. J. H. Clemmer, Blue Creek, W. Va.

FOR SALE—Motor, $10; Headset, $4; 1-inch Coil, $3; a Potentiometer, $3; Detector, $2; Spark Gap, $1; Sending Condenser, $2. Paulding, Canterbury School, New Milford, Conn.

FOR SALE—Alternating Current Electric Sewing Machine Motor, $15; new condition; cost $30. H. N. Richmond, 1628 Washington Ave., Colorado Springs, Colo.

WANTED—Second-hand generator suitable for charging storage batteries. Must be in first-class condition. Archie E. Banks, Delmar, Va.

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EXCHANGE—6 volt, ⅛ horse-power motor; 110 volt, 1/16 horse-power motor, 110 volt ammeter. Want audion, 1 K.W. quenched gap, or other apparatus. Ira Wright, Closson St., Methuen, Mass.

FOR SALE OR EXCHANGE—28 ft. Curtiss aeroplane, without motor; crated; will sell cheap; want $100 cash. Make offer. V. G. Gustafson, Joliet, Ill.

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FOR SALE—Complete Audio-Tron on panel with all controls and 4-40 storage battery. Panel has 2 D.P.D.T. mineral change-over switches wired on. Used 10 hours. $10. Also "Arlington" 4,000 M. Coupler, cost $9, for $6.60 and $4. Murdock Oscillation for $3. George R. Hammond, Oelwein, Iowa.

WILL EXCHANGE my Twin-Cylinder, 6 H.P. Merkle motorcycle, in perfect condition, for good wireless apparatus. Francis Joannini, 3326 17th St., Washington, D. C.

FOR SALE—Set Cyclopedia of Applied Electricity. Send for description. All letters answered. J. N. Boyington, South Galena Ave., Freeport, Ill.

FOR SALE—Three undamped wave loading coils less sliders, $5. Brand new Chambers No. 749 loose coupler, bargain. Write H. A. Guenzel, 410 Buttonwood St., Philadelphia, Pa.

WANTED—Brandes or Murdock 2000 ohm headset for $3. A. Taylor, 105 East 102nd St., New York.

WILL EXCHANGE first-class wireless set for "Smith" motor wheel, or Motorcycle. Bernard Brown, Troy, N. C.

SLIGHTLY used printer's type for sale cheap. Geo. Wasserberger, Neillsville, Wis.

$75 Chicago University advertising course, 6 volumes with questions for sale for $8 Write if interested. Geo. Wasserberger, Neillsville, Wis.

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BARGAINS—Selling out music. Over $3 value for $1. Sample 10c. B. Scholz, Majestic Theatre Co., Sheboygan, Wisc.

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PATENTS—R. Morgan Elliott & Co., Patent Attorneys, Mechanical, Electrical and Chemical Experts, 716-724 Woodward Bldg., Washington, D. C.

151 LAKE AVE.,
Lancaster, N. Y.
Feb. 22, 1917.

Gentlemen:

I wish to tell you that my ad. in the E. E. was a great success, and exceeded all expectations. I had replies before I had received a copy of the issue myself. This goes to show that every issue is looked for with great interest, and the wide field your paper covers. I certainly will recommend it to the amateurs that have something to trade or sell.

Yours respectfully,
G. W. BRADFORD.

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FOR SALE—$35 R.A.-6, $28. Special $42.50 R.A.-6, genuine polished mahogany Formica panel, $33. $15, 3,000 meter coupler, $9.75. Regenerative panel with vacuum bulb, variometer, condensers, rheostat, etc., $14. 1,000 meter coupler, special for above panel, $5. 5,000 meter loading coil, switch and 12 points on hard rubber panel to be used with above coupler, $5. All above high grade, brand new instruments. Also one used electron relay cabinet, damped and undamped hookup with bulb, $8. V. G. Gustafson, Joliet, Ill.

FOR SALE—To dispose of the following instruments, I am offering same far below the original cost. Three sections, Murdock Moulded Condensers, $4. One K. W. Oscillation Transformer, $4. Sayville Rotary Spark Gap, $9. E. I. Co., Transatlantic Phones (2,000 ohms) $4. The above-mentioned instruments are in first-class condition. If interested, write for particulars. Charles W. Havlena, 934 18th Ave., E., Cedar Rapids, Iowa.

AMATEUR BENCH LATHE—Austin make, 8" between centers, 3 speed pulley, very strong, neat and efficient. Price only $3, worth double. Limited supply on hand. Louis E. Schwab, 3708 Brooklyn Ave., Cleveland, Ohio.

WANTED—One K. W.—Have Willard Storage Batteries to exchange. Large Tesla and Oudin coils, $3.24 and $2.75. Panel loose coupler, $4.25, etc. Telephone ringers, 60c; coils, 3 for 25c. Stamp for pictures. Garden City Radio Club, Garden City, Kansas.

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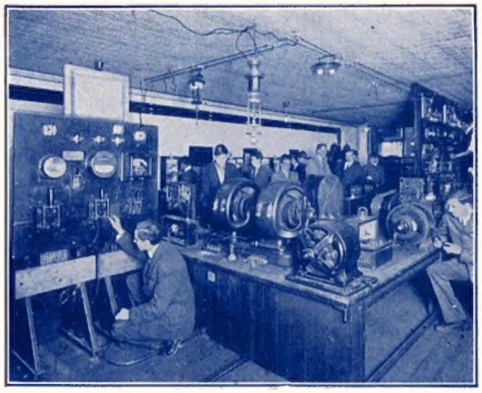

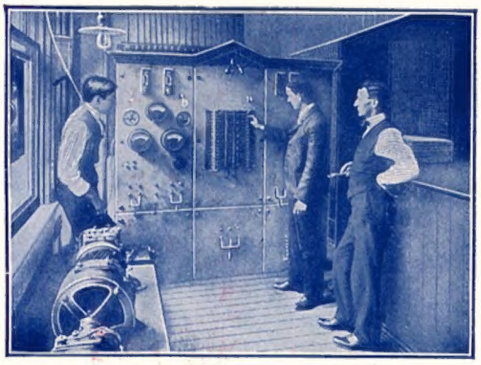

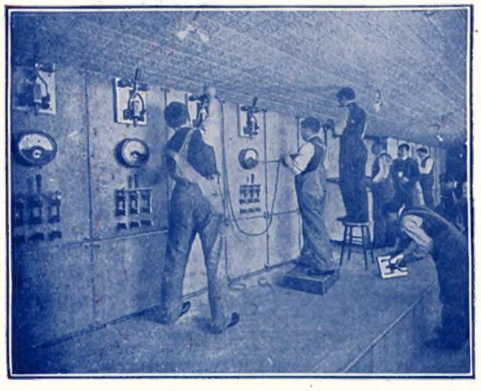

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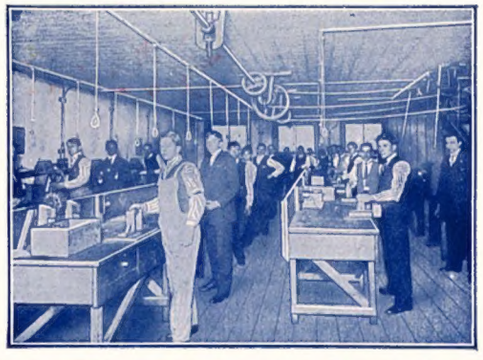

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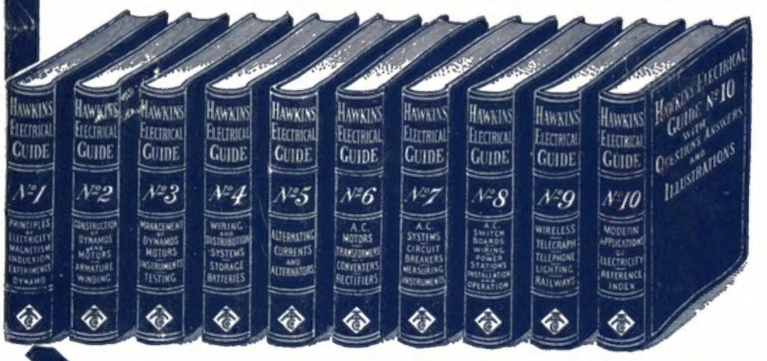

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